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The

Tropical Agriculturist

JANUARY TO MARCH, 1947.

EDITORIAL

THE COCONUT INDUSTRY

THE present world shortage of fats is estimated by some to last till about 1960, on the footing that the demand remains stationary at pre-war levels. Needless to say, the magnitude of the demand will diminish continuously as the production machinery disrupted by the war returns step by step to normal conditions. The Coconut Industry, then, will enjoy a decade, at least, of undeserved prosperity—undeserved, because the industry as a whole had done very little since the depression even to supply vacancies, much less to improve its standards of cultivation. The degree of prosperity will be limited, of course, by the extent to which internal conditions remain tranquil and balanced. After that, what will be its fate ?

There are still many who look longingly and hopefully back to the good old days when the Industry was invested with the smug title of the " Consols of the East "—even though Consolidated Annuities have themselves now ceased to be a symbol of rock-like constancy in the financial world. The semi-monopolistic market that the Coconut Industry once enjoyed and which brought in its effortless dividends has gone, never to return. Whale oil, on the one hand, and competing oil seeds, on the other, can be relied on to disturb its economic stability pretty effectively.

There are others who, by multiplying an individual's fat requirements according to correct nutritional standards by the world's population, predict that, far from there being a glut in the oil seeds market, there is likely to be a progressively increasing demand. They base their calculations on the collective conscience of the world which, being now roused to the supreme importance of correct feeding for mankind, will pursue that objective until the aim is achieved. There can be no doubt that if the fat requirements of every person in the world are met even to a limited extent, the prospects for the Coconut Industry are likely to be extremely rosy for a very long time. But how far the collective conscience of the world can be impelled to do what is right within a reasonably short period is something about which very few

will care to speculate. It is a significant fact that the collective conscience of the world shows signs of sentience only during periods of stress and is prone to resume its slumbers when the tension has disappeared. Suffice it, therefore, to say that to be lulled into a feeling of security by this possibility is to be somewhat imprudent and unrealistic.

There are also other optimists who have already begun to pin their faith on the much publicised millennium of a brave new world for our economic salvation—a world in which the nations would join in brotherly amity and decide how each should utilize its resources so that all may live in plenty. Already, we can see the walls of this brave new world toppling in ruin before rival ideologies, rival greeds and rival hates; and the nations that met to solve the problems of the world are talking—suavely and politely, of course—across the conference table, with their hands in their pistol pockets. The looked-for millennium is thus receding rapidly into the background. No wonder, then, that the Ceylon Government, with commendable realism, has appointed a Commission to decide what should be done to 200,000 acres of its rubber which have become uneconomic because its partner in a bulk purchase scheme found it possible to buy rubber at 60 cents a lb. in other quarters, although it had thankfully accepted the commodity at Re. 1 a lb. at a critical time when the market value could have been several times that price. This rubber transaction reveals one defect in these bulk purchase schemes in relation to world trade. If there is more than one producer, brotherly amity will incline towards the brother that sells for less.

The same fate will undoubtedly overtake the Coconut Industry of this Island when other fat and oil activities are operating at maximum potential. Already, we hear of an undertaking in Tanganyika and the neighbouring countries for the production of 800,000 tons of ground-nut per year—an undertaking that is to cost £24,000,000, and which involves the construction of a special port for the handling of the merchandise. The operation is to be financed by British capital. Is it to be wondered at if, in the future, the oil requirements of the United Kingdom are met on the basis of a priority for this source? This enormous expenditure on the part of the United Kingdom may be regarded as a pointer to the possibility—or rather, the impossibility—of depending too much on a pre-planned system of international trade.

The Coconut Industry of this Island cannot, under normal conditions, have much influence on the oil seed market of the world. Is the Ceylon coconut grower, for that reason, to await the impending doom with resignation, and not do anything about it? It seems, however, that there is no cause for pessimism if he but follows closely the economic and agricultural trends within his own country and plans for the development and for the satisfaction of an internal demand.

In Ceylon, as elsewhere, the vital necessity of a proper nutritional level for its inhabitants has been fully recognised as the most important item in its programme of development. The milk needs of this country, at a minimum, have been estimated to be 100 million gallons a year. Our production at present is only 20 million gallons. Dr. Norman Wright, in his recent report, fixed our requirements in milch cattle, for this purpose, at 375,000 animals, producing 300 gallons per year each. Obviously, he has worked on the basis of a yield of one gallon per animal over a lactation period of 300 days.

Let us adopt this as a working hypothesis for our calculations, though local conditions make a few corrections necessary to relate it to actuality. This involves feeding each cow with a production ration of 3 lb. of concentrates per day. It is presumed here that the maintenance ration will be supplied by grass. Each cow will therefore need annually 900 lb. of concentrates. If we utilise coconut poonac for the purpose, this works out at the equivalent of about 2,500 lb. of copra or 4 candies—the annual yield of roughly 2 3/4 acres under coconut. It will thus be seen that if our requirements of concentrates are met from local resources, the entire existing acreage will have to be utilised for supplying our needs. No account is taken here, of course, of our draught animals and other livestock.

Let us examine the question of coconut exports from another angle. In this country, where the food needs of its inhabitants are notoriously dependent on the industry and bounty of other lands, it is a relief to be able to say that its fat requirements are met for the most part from internal resources. It is estimated that no less than 750 million coconuts are annually consumed in this country as human food. The process of utilisation is important. The kernel is scraped, incorporated with water and pressed through a colander. The " milk " so extracted is used as a base for preparing curries. The residues in the colander are put to such minor use as feeding poultry. As against these 750 million nuts, about 670 millions or their equivalent in partly processed products are sent out of the country mainly in the form of copra, or desiccated coconuts, oil or poonac. In recent times, a very large trade in the export of nuts themselves has also arisen. Of these two sides of the Coconut Industry, there can be no doubt whatsoever that the former enures more to the benefit of the country than the latter. For it loses very little of its capital wealth in the process.

In assessing the relative value of exports in the economy of this Island, it is important to bear in mind the relation of the exported material to the depletion of the country's soil. When exporting rubber, for instance, in the form of smoked sheets, we are actually exporting a compound consisting of a mixture of hydrocarbons. Its constituents, therefore, are obtained from the atmosphere and are illimitable in quantity, and the soil loses little or nothing in the process. Its export does not appreciably alter the balance of minerals in the soil. Whatever the rubber tree takes from the soil, it surrenders to the soil when it ceases to live. It is, therefore, a beneficent crop in more senses than one. The case of coconut produce is entirely different. What is exported is the fruit and with its transport overseas, the country loses in a normal year roughly 1,200 tons of nitrogen, 500 tons of Phosphoric Acid, 450 tons of Potash and 325 tons of Lime. The nitrogen is a particularly severe loss, as it is in the form of readily assimilable protein which is very useful for feeding livestock.

The only product of the coconut that we can export without loss is the oil itself. It consists of Carbon, Hydrogen and Oxygen in chemical combination and as these are derived mainly from the atmosphere, there is no objection to its export, from the point of view of the maintenance of soil fertility. Two-thirds of the copra consists of oil; the balance in the form of poonac must be put back into the soil, preferably through livestock.

Especially at this juncture, when the balance of trade is turning so heavily against us, the practice of exporting poonac or desiccated coconuts or the kernels themselves is to be deprecated. The whole process savours of soil mining and we are living on our capital without knowing it. A careful revision of the policy towards the export of coconut products other than oils seems called for, for both these important reasons. The illusory advantages of high prices outside should be weighed carefully against the damage that the capital wealth of the country suffers in the long run. A plan that will enable the fertility of the soil to be preserved, while the nutritional level is substantially advanced at the same time, is one that is worthy of consideration.

RECENT STUDIES ON THE MANURING OF COCONUTS IN CEYLON (CONTINUED)

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(5) MANURING OF FODDER GRASSES GROWN BETWEEN PALMS

Among others may be mentioned an experiment carried out at Kirimetiana Estate, Lunuwila, from December, 1939, to the end of 1943 to study the problems of manuring and management of fodder grass (Napier) planted between palms. The treatments tested were O, N and NPK with and without fodder. The bare results may be summarized as follows :— (*a*) Where no manures were applied, the growing of Napier between palms depressed the yield of copra up to almost 39 per cent. in the 4th and concluding year of the experiment, (*b*) Heavy applications of N. produced a slight set back of 10 per cent. in the copra yield of the " *No-Fodder* " plots. On the contrary the applicaton of this dose of nitrogen to the fodder brought about an increase up to 44 per cent. over the " *Fodder* " plots to which no manures were applied. This may be because excess nitrogen is taken up by the growing fodder and a set back thereby prevented, as conclusion based on the Bandirippuwa Experiment, (*c*) In the " *No-Fodder* " plots NPK complete mixture produced an increase of yield up to 38 per cent. over the unmanured plots ; and a corresponding increase of yield of 59 per cent. in the " fodder " plots over its corresponding " control " plots, (*d*) Growth of fodder was poor and only 3 cuttings per annum were obtained in the later stage of the experiment. Manuring with NPK increased the yield of fodder grass eightfold, but taking the maximum yield of the NPK plots no more than 4 tons per acre per annum was obtained—a poor yield indeed.

It should also be remembered that Napier grass has an unusually high potash requirement as shown by Burton and Lefebure recently (11) and should therefore compete with coconuts for this essential requirement.

Under the dry conditions prevalent in most coconut areas the possibilities of growing Napier between palms and that without affecting the yields of copra seem remote. Perhaps Guinea Grass may have been a better choice. A more hopeful line seems to lie in improving existing coconut pastures on better principles of management by introducing legumes and by rotational controlled grazing and avoiding over-grazing. Therein lies a field of investigation awaiting development. Cattle and pasture form an important link in the fertility cycle of coconut estates.

Further, the flush of fodder grass is obtained during the wet months when estate cattle have adequate pasture, while during droughts when

a succulent reserve of food would be useful, there is very little growth. Trials in ensiling the fodder in a small tower silo were not particularly successful. Coconut black beetle was found to breed in the ensilage.

(6) COVER CROP EXPERIMENT

We now come to a manurial experiment on a rather controversial subject—cover crops, their utilization and manuring, laid down at Bandirippuwa estate in 1937 on an area of lateritic gravel, the poorest fields of the estate. The cover tested was Centrosema.

TABLE IX.
COVER CROP EXPERIMENT

Adjusted Mean Yields per Acre. (66 Palms.) (lbs. Copra Acre.) per annum.

Treatment.— Year :	G. I. 1937–1938	G. II. 1938–1939	G. III. 1939–1940	G. IV. 1940–1941	G. V. 1941–1942	G. VI. 1942–1943	G. VII. 1943–1944
No. Cover NPK	..	1406	1185	1369	1406	1974	1674
Cover K	..	1207	624	1266	1185	1875	1417
Cover NK	..	1200	782	1340	1164	1894	1453
Cover PK	..	1193	631	1218	1072	1813	1442
Cover NP	..	1233	738	1127	1145	1618	1303
Cover NPK	..	1241	829	1365	1270	2030	1556
Standard Error	..	106·1	81·5	91·4	174·3	173·6	182·4
Significant Difference P·05		126·2	96·9	109·0	207·0	206·3	216·9

The results of the differential manurial treatments are summarized in Table IX, from which the following conclusions can be drawn : (*a*) The growth of the cover crop produced a sharp decline of yield which reached a peak in the third year. This, it may be mentioned coincided with a severe drought, which no doubt enhanced the set-back ; (*b*) The incorporation of covers along with manures at the end of the *second year* caused a recovery in the cover plots in the *fourth year*. This recovery has been maintained in the subsequent years ; (*c*) There was no significant difference between palms manured with a complete NPK mixture without cover in circular trenches when compared to palms where cover was also grown and the same mixture broadcast and turned into the soil along with the cover ; (*d*) There is no significant difference between the yields produced by the addition of K, NK and NPK where cover is grown and turned in along with manure ; (*e*) Absence of potash (*i.e.* only NP) produced a significant decline in yield where cover is incorporated. Once again the importance of potash is confirmed.

It has not been possible to carry out parallel laboratory investigations to study—(*a*) The nitrogen changes in the soil, (*b*) The phosphate problem and (*c*) Moisture content of the soil.

The above results are strictly applicable to lateritic gravels and may not hold true to other soil types under different climatic conditions, but none the less the dangers of growing covers and having them untreated during droughts competing for soil moisture with the palms have to be kept in mind.

TABLE X.

Profit or loss from manuring Good Soil based on data of manurial experiment at Bandirippuwa Estate, when Price of Copra and cost of manuring vary.

Average biennial increase due to manuring (9-year period) = 496 lbs. = ·885 candies per acre in 2 years.

PROFIT OR LOSS PER ACRE DURING TWO-YEAR PERIOD.							
Price of Copra per Candy	Gross Value of Increase Yield due to Manuring	Cost of Manuring once in two years.					
Rs.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Per palm
—	—	0 50	0 75	1 0	1 25	1 50	
—	—	30 0	45 0	60 0	75 0	90 0	Per acre (60 palms.)
20	17 70	—12 30	—27 30	—42 30	—57 30	—72 30	
30	26 55	— 3 45	—18 45	—33 45	—48 45	—63 45	
40	35 40	5 40	—19 60	—24 60	—34 60	—54 60	
50	44 25	14 25	— 0 75	—15 75	—30 75	—45 75	
60	53 10	23 10	8 10	— 6 90	—21 90	—36 90	
70	61 95	31 95	16 95	1 95	—13 05	—28 05	
80	70 80	40 80	25 80	10 80	— 4 20	—19 20	
90	79 65	49 65	34 65	19 65	4 65	—10 35	
100	88 50	58 50	43 50	28 50	13 50	— 1 50	

TABLE XI.

Profit or loss from manuring Poor Soil based on data of manurial experiment at Ahangama when Price of Copra and cost of manuring vary.

Average increase due to manuring during 2 years —1,052 lbs. or 1·875 candies per acre.

Price of Copra per Candy	Gross Value of Increase due to Manuring	PROFIT OR LOSS PER ACRE DURING TWO-YEAR PERIOD					
		Cost of Manuring once in two years.					
Rs.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Per palm Rs.
—	—	0 50	0 75	1 0	1 25	1 50	
—	—	30 0	45 0	60 0	75 0	90 0	Per acre Rs.
20	37 58	7 50	— 7 50	— 22	—37	—62	
30	56 37	26	11 37	— 3 63	—19	—34	
40	75 16	45	30	15	Nil	—15	
50	93 95	64	49	34	19	4	
60	112	82	67	52	37	22	
70	132	102	87	72	57	42	
80	150	120	105	90	75	60	
90	169	139	124	109	94	79	
100	188	158	143	128	113	98	

(7) MANURING OF UNDERPLANTED YOUNG PALMS

An experiment laid down at Letchemy Estate, Nattandiya, to study the problems of manuring of young palms underplanted is now in its fifth year. Height measurements and leaf counts of each seedling as it develops have been kept; but until the palms come into bearing it is considered premature to draw any conclusions, *as both height and leaf growth have yet to be proved as being reliable standards of productivity.* It is of interest to record that one palm (in the 6th year) has just come into flower.

(8) ECONOMICS OF MANURING*

In considering the economics of manuring and the application of the Law of Diminishing Returns, not merely the soil conditions controlling the response, but also the following combinations of economic factors have to be considered: (*a*) Low prices of copra and low prices of manures such as prevailed from 1930 to 1941; (*b*) High prices of copra and a proportionately higher price of manures such as prevail today; (*c*) High prices of copra and low prices of manures as prevailed in the pre-depression period up to 1930. The case of low price of copra and high price of manures need not be discussed, as manuring under such conditions is unlikely.

The following items of importance today in the cost of production have to be carefully kept in mind :—

(*a*) The rise in the price of manures, an increase nearly threefold compared to pre-war conditions.

(*b*) The rise in cost of labour from 40 cents pre-war to Re. 1·30 today involving a heavy charge for the cost of application. On gravelly soils it costs nearly 25 cents or more to cut and close a manure circle, so that the all-in cost manuring is about Re. 1·25 to Re. 1·35 per palm.

At the present levels, the cost of manuring fully at the level recommended by the Coconut Research Scheme is about Rs. 95 per acre every two years, or Rs. 47·50 a year. It will be shown later that this will be an economic proposition—particularly on poor soils—with a guaranteed copra price of Rs. 125 for five years. Admittedly, however, it is a high initial cost to bear for those properties which perforce neglected for many years, are only giving crops of the order of 1,000 nuts an acre.

With the copra price stabilized at a fair level for five years, there is every incentive to planned economy.

In Table X and XI, I have presented an analysis of the economics of manuring on profit and loss basis under varying prices of manuring and copra, based on a sliding scale, for the good soils as represented by the N. P. K. experiment at Bandirippuwa Estate (Table III.) and on poor soils by the data of the Ahangama experiment (Table IV).

In the case of the good soil, the average annual increase for the nine-year period, for the higher dose of potash, comes to 248 lbs. copra or 496 lbs. biennially, *ie.*, 0·885 candies (Table III). It will be seen that even at Rs. 40 a candy, manuring would just pay when prices of manures were cheap as under pre-war conditions, assuming manuring is biennially and regularly continued for at least 4 manuring cycles.

Even when copra is Rs. 100 a candy, manuring is a loss when cost of manuring is Re. 1·50 per palm. At Re. 1·25 per palm for manuring and

* This section has been revised to bring the information to date.

copra at Rs. 100 as today, there is a small profit of Rs. 13·50 per acre biennially. This, of course, assumes a long-range stabilised copra market, which is high even beyond five years. Assuming an average copra price of Rs. 50 on good soils, the limit of cost of manuring per palm should not exceed 50 cents.

In such soils we should not foster the delusion that after one or two applications of manure all's well. Fortunately or unfortunately such high yielding soils form only a small acreage comprising the alluvia of the Ma Oya and Deduru Oya valleys, the estuarine deposits between Ma Oya and Deduru Oya estuaries and of the Puttalam and Battuluoya Lagoons. *On such soils high farming is no remedy for low prices.*

On the poor soils, which I again repeat, form the major percentage of the Island, and which must demand our immediate attention, the case is different. Besides improving the capital value of such lands manuring brings in an immediate and profitable return. Even at Rs. 20 copra per candy manuring is just profitable when price of manuring is 50 cents a palm. At this price of manuring, the profit is nearly Rs. 158 per acre biennially when copra is Rs. 100. Even at Rs. 1·50 per palm for manuring it is just paying at Rs. 50 copra and at Rs. 100 copra the profit is nearly Rs. 100.

In 1937, nearly 10 years ago, in a press article entitled : " Economic manuring and cultivation of coconuts in Ceylon " (33) I put forward this same theory of economic manuring based on the interpretation of the Law of Diminishing Returns. It has now been confirmed by subsequent experimental data which were not available at that time.

Today, with an assured, stabilised copra market I must reiterate these views and call upon all those who possess coconut estates, neglected and not manured since 1930 when the depression began, to beg or borrow and manure somehow and that with expedition.

Replanting cannot produce any visible effects on crops for many years, whereas it is a reasonable inference from our data that on poor soils an increase of 1,000 nuts per acre per annum will be realised by adequate manuring after fifteen months.

On this basis, if 100,000 acres, a very modest extent indeed out of a total acreage of one million acres of coconuts are manured annually, the increase of crop would be 200 million nuts, so that the alleged decline in production can be easily caught up in 3 years. 100,000 acres annually in a 5-year plan is far too low a target with a stable market, and our aim must be at least 300,000 acres annually, by propaganda, credit facilities and Government assistance as a national effort on the lines of the Co-operative Aided Manure Scheme. This would mean an increase of 600 million nuts based on a modest estimate. This must indeed be our aim and all those who have the interest of the industry at heart must join in this campaign.

Indeed, if prices of manures come down as they are likely to do, more intensive manuring with higher doses aiming at a higher level of response of even 1,500 to 2,000 nuts per acre per annum on a linear incremental basis should be our target. These calculations are not ideal day-dreams or a mere counsel of perfection, but based on scientific realities, which we must and can achieve so that not a single poor yielding estate remains unmanured, and an average yield of at least 2,500 nuts per acre per annum obtained, or the present production more than doubled.

A complete discussion is not possible during the time at my disposal. I have endeavoured to summarise nine years' investigations on the manuring and nutrition of the coconut palm. Nine years in the life of the coconut palm is a short span—barely equal to 9 months in the life of an annual crop. The latter period is indeed significant—and to use a human analogy—be considered a gestation period in a programme of studies of the nutrition, physiology and manuring of the coconut palm.

The next stage must follow when these preliminary, yet let us hope, useful data, develop into a more consolidated programme of planned investigations on more ambitious lines. With enlarged resources and expansion of staff we hope to obtain in the not very distant future, it is our hope that before the end of the next decade further light will be shed on the life, growth and development of the main agricultural crop of this Island—once indeed the Consols of the East.

ACKNOWLEDGMENTS

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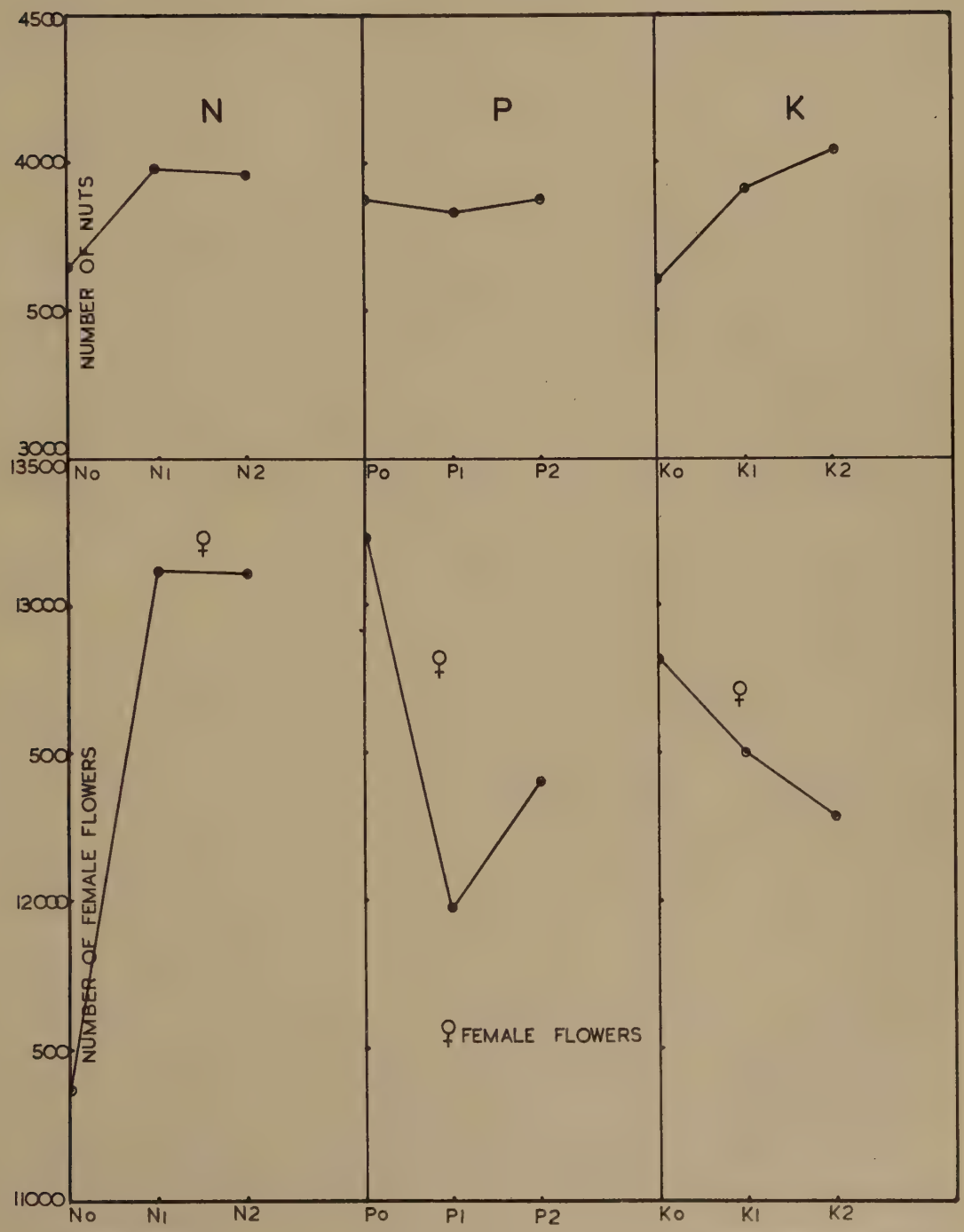
DIAGRAM 6·

FEMALE FLOWERS AND NUTS·

MEAN OF 6 YEARS (MIII to MVIII)



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THE POSSIBILITIES OF THE UTILIZATION OF DDT AND GAMMEXANE FOR PLANT PROTECTION IN CEYLON

T

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DURING the past five years two important new insecticides have come into prominence as being the most effective insect poisons so far discovered for dealing with insect pests. These are " DDT " and " Gammexane (666) ", two synthetic organic chemicals. They have much resemblance to each other in their properties as far as methods of application and toxicity to insects are concerned. The general principles of the irutilization will thus be largely controlled by the same factors.

" DDT " or 2, 2-bis (parachlorophenyl), 1, 1, 1-trichloroethane or dichlorodiphenyltrichloroethane, was first prepared in 1874 by Ziedler. The chemically pure substance is a crystalline solid, practically colourless and almost odourless. It is relatively stable and has low volatility. It is insoluble in water but soluble in most organic solvents. In 1936, J. R. Geigy of Basle, Switzerland, discovered that it possessed insecticidal properties. It has been very extensively used during the war for the control of mosquitoes, flies and household pests. Since 1943 it has been widely tested as an insecticide for use against insects attacking plants and domestic animals, and its insecticidal effectiveness contrasted with the commonly used insecticides like the Arsenic, Pyrethrum, Derris and Nicotine products. Comprehensive large scale field trials have, however, been relatively few on account of supplies not being available during the war for general or civilian use.

Gammexane or 666, the Gamma isomer of Benzene hexachloride or 1, 2, 3, 4, 5, 6–hexachlorcyclohexane, is a substance rather similar in appearance and general physical properties to DDT. It is rapidly decomposed in the presence of alkalies but it is stable in the presence of ground limestone or chalk either dry or in water at ordinary temperatures. Its insecticidal usefulness was discovered by Raucort in 1941 in connexion with the control of the clothes moth when it was found to be superior to Napthalene and Paradichlorobenzene, and by Thomas and others in 1942 in connexion with the control of the Turnip flea beetle in England. Subsequently, it has been tested against various agricultural pests on the majority of which it has shown a high toxic effect, comparable with the results achieved with DDT and far superior to the common insecticides.

Both DDT and Gammexane can be used as dispersible powders diluted with selected materials or in solution in an organic solvent, these solutions being diluted for use with kerosene and other suitable oils. Against mosquitoes and household pests, where water sprays are not necessary, relatively high concentrations of the active ingredient can be used and from 5–10 per cent.

of the insecticides have been applied. A 5 per cent. DDT in kerosene has been generally found to be the most economical method of spray application in these cases. For agricultural use, however, where water sprays are required only much lower concentrations have been available for use as sprays. As dusts higher concentrations have been available.

The insecticidal properties of both these substances and their manner of action appear to be somewhat similar. Their toxicity to almost all insects against which they can be applied is definitely greater than that of the well known insecticides generally used for the control of agricultural pests. In their mode of action they appear to act as nerve poisons and are effective both when ingested with food or when absorbed through the outer body wall. The first symptoms are the twitching of movable organs. This is followed by paralysis of the legs and eventually collapse and death. The speed of knock-down especially with Gammexane is not so great as that given by Pyrethrum. It is largely dependent on the size or body weight of the insect, as well the general habits and activity of the insect in cases where the spray or dust is not directly applied on them. Death occurs with few exceptions only several minutes or hours after the actual exposure to the insecticide. Apart from the direct effect obtained by application of the insecticide on the body or food of the insect, both insecticides have a very potent residual action, being effectively absorbed from surfaces to which the insecticide has been applied through the tarsi of the legs. This residue is able to withstand atmospheric conditions and is thus effective for several days after application, thus contributing a cumulative effect and greatly increasing mortality. There is of course individual variation depending on the particular insect and insecticide used and the nature of the application on the plant surface.

From trials already carried out in various countries, DDT has been found to be more effective than other standard insecticides for insects of such widely different habit as surface feeding beetles and caterpillars, sucking insects and even certain boring insects. It has also been successfully used against stored grain-infesting insects and soil insects. Gammexane has not been so extensively tested but has given more or less similar results, showing a toxicity value equal to or greater than DDT in the majority of cases. It has also been clearly shown in actual tests both on a laboratory and field scale that the insecticidal effectiveness of these two substances against practically all the insects tested is not less and is usually far superior to other insecticides which can be used. Amongst insects which are extremely sensitive to DDT are the Diptera including the flies and mosquitœs, and it has been very successfully used on a large scale in controlling these pests. Many tests have also been carried out against important agricultural pests with DDT. In America DDT has been found to be far superior to Derris, Pyrethrum and Nicotine against Cabbage caterpillars. It has been found to be superior to arsenates for the control of the cotton boll weevils, bollworm and cotton bugs. As an orchard spray against Codling moth and other pests it has been found to be superior to arsenate sprays. It has also been found to be very effective on sucking bugs such as, Capsids and leaf hopper pests against which it has been difficult to utilize other insecticides economically in order to effect a satisfactory control. On the other hand it is very toxic to bees and other pollinating insects, as well as to parasitic and predatory insects which effect in many cases a natural control of pests. It is also toxic to fish and crustacea but fortunately rather less so to birds and mammals.

As far as man and domestic animals are concerned the concentration of these insecticides in applications to plants is too small to cause any harm or produce any toxic symptoms. They are, however, very much more toxic to all animals as an emulsion than as an oil or suspension and particular care should be exercised if an emulsion is used. Sprays have better residual effects than dusts, the deposit being more stable and not affected by the mechanical effects of rain.

DESCRIPTION OF TRIALS

In Ceylon these insecticides have only been available in sufficient quantity for tests on a laboratory scale and trials have been directed chiefly towards ascertaining the relative degree of toxicity for individual pests with a view to working out effective dosage strength and the most suitable manner of application in the field. In addition to the descriptive account given, the final observations on mortality are recorded in comparative tables.

Stored grain insects.—In carrying out the trials a sample size of 125 oz. of grain was used and storage done in jute hessian bags placed on a cement floor. Green gram, cowpea, and wheat were used, the two former being infested with *Bruchus chinensis* L., and the wheat with *Calandra oryzae* L., and *Rhizopertha dominica* F. Insecticidal dusts were the proprietary products D025 (666) and Gesarol (DDT). Preliminary tests showed that dosages of less than ·025 per cent. Gammexane and ·012 per cent. DDT became progressively infested after 4–6 weeks of storage. Dosages of ·025 per cent. (666) and ·012 per cent. DDT were the most suitable and were found to destroy all insects in the grain and to keep grain free from attack for a period of 6 months and over. The use of higher dosages did not make an appreciable difference to the effectiveness of the treatment. No detrimental effect on germination was experienced and no ill effects were produced on poultry fed with the treated grain for a continuous period of 2 weeks.

Leptocorisa varicornis F.—The insects were exposed to the insecticides in cages containing the host plants where the plants alone were treated and also where the internal surface of the cage as well as the plants were treated. In the former case the insects were retained in the original cages into which they were introduced. In the latter they were transferred to untreated cages after a specific period of exposure in the treated cage. Mortality was taken as the point at which the insect was unable to support itself upright on its legs, and observations regarding mortality were noted only up to a period of 48 hours after the time of initial introduction of the insects. Insecticidal preparations used were made from Geigy's Gesarol (DDT) and Imperial Chemical Industries products, D025 and D919.

Preliminary tests showed that there was no appreciable difference between effects on adults and effects on 3rd and 4th instar nymphs, and final tests were made only using adults. Dust applications of lower than 3 per cent. active principle were not sufficienctly effective when applied only on the plant surface, giving an incomplete and inconstant mortality. Dusts containing 3 per cent. and over of active principle were very effective producing 100 per cent. mortality. The effectiveness was retained on the walls of the cage for a period extending up to 3 weeks, but was not sufficiently retained on the plant surface to produce effective mortality for a period longer than 5–7 days. Gammexane seemed to be more toxic to the insects than DDT, producing quicker mortatilty and longer residual effect.

DDT was tried also as a spray. A spray containing ·1 per cent. active principle produced no appreciable effect unless insects were exposed to it for a continuous period of not less than 6 hours in cages which had all surfaces treated with the insecticide. Spray application containing ·5 per cent. active principle gave 100 per cent. mortality after exposure for 2 hours. The effectiveness of the spray application was retained for nearly one week on plant surfaces and up to nearly 2 weeks on the surface of the cage.

Dacus cucurbitae Coq.—Insects were obtained from material collected from Cucumber and Snakegourd. Treatment was similar to that given to *Leptocorisa*. With insecticidal dusts containing 3 per cent. active ingredient, a 5-minute exposure to the treated surface was sufficient to produce 100 per cent. mortality. The mortality was reduced to 20 per cent. on the 5th day after application, the count being taken only up to 48 hours after original introduction. An exposure of two hours to the insecticidal surface gave 100 per cent. mortality, effectiveness being retained for nearly 2 weeks. Exposure to a surface sprayed with ·1 per cent. DDT gave 100 per cent. mortality with 6 hours continuous exposure, the surface remaining effective for 2 weeks. Insects exposed in cages in which plants alone were treated gave a 100 per cent. mortality up to the fifth day of treatment and over 50 per cent. mortality up to 8 days in the case of dusts containing 3 per cent. active ingredient.

Aularches miliaris L.—The insects used were 4th and 5th instar nymphs. Preliminary trials showed that at least 2 hours exposure period is necessary to bring about appreciable mortality as the movement of insects in the cage is relatively little. The insects were very much more sensitive to Gammexane than to DDT. A 2 hour exposure to dust containing 1 per cent. Gammexane produced 100 per cent. mortality. The effectiveness of the treated surface was retained for 1 week. With DDT a 2 hour exposure to a 3 per cent. dust failed to produce any mortality, while continuous exposure produced appreciable but not total mortality.

Agromyza phaseoli Coq.—Insects were kept in cages in which the plant surface alone was treated. A mortality of 100 per cent. was obtained for periods extending up to 10 days after initial application of dusts containing 3 per cent. active ingredient. The spray containing ·1 per cent. DDT was slightly less effective. In the application of the insecticides to garden plots it was found that appreciable mortality of plants through Agromyza attack was obtained when the insecticide application was carried out at intervals longer than 4 days. Both insecticides appeared to be equally effective.

Prodenia litura F.—Caterpillars of the 3rd and 4th instars were used for trials. The insects showed much reluctance to feed on treated leaves. Total mortality was obtained with both insecticides in dusts containing 3 per cent. active ingredient. A residual effect was maintained for over 4 days which was as long as leaves could be maintained in a suitable condition for feeding the caterpillars. A spray containing ·1 per cent. DDT was also effective and produced a mortality of 80 per cent. as compared with a 15 per cent. mortality in a parallel test in which Lead Arsenate was used at the rate of 1 oz. in 2 gallons of water. Observations were only carried out up to 2 days after the original introduction of the insects.

Miscellaneous insects.—Mortality ranging from 80–100 per cent. was obtained in the treatment of a number of insects attacking growing plants in the field, using a 3 per cent. Gammexane dust prepared from D025. Amongst these were *Ragmus importunitas* Dist. on Sunn-hemp : *Bagrada picta* F. on Radish : *Aulacophora intermedia* Jac. on cucumber : *Crocilodomia binotalis* Z. on cabbage : *Dorylus orientalis* Westw. on Radish : toxicity towards Honey Bees and parasitic Hymenoptera was found to be extremely high and comparatively greater than towards any of the destructive insects tested.

Phytocidal effects.—No appreciable scorching was produced on mature foliage by dust preparations containing less than 5 per cent. active ingredient of either insecticide. Slight scorching was produced by 3 per cent. dusts and ·1 per cent. sprays of both insecticides on tender foliage of Cucurbitaceous plants and and French beans.

DISCUSSION AND CONCLUSIONS

It appears from a comparison of these results with those obtained in other countries that the general insecticidal effects of these insecticides on crop pests in Ceylon have not been of such a high degree of potency as that which seems to be obtained from trials carried out in temperate countries. It is likely, therefore, that generally slightly higher dosages will be necessary in Ceylon. The degree of toxicity obtained however is quite relevant to claims made for these insecticides and definitely surpasses that of the older insecticides in common use. Despite this potency very much field experimentation is necessary before their economic value can be properly estimated and definite recommendations made for their use for general agricultural purposes in Ceylon. Even laboratory tests have indicated that the high insecticidal effects obtained for these insecticides may not be reflected by a corresponding high mortality in the field. Much will depend on the general habits and activities of the insects under natural conditions and the ecological factors of the area.

On the other hand the high insecticidal value of the substances can make them akin to a two-edged sword, as they could act equally effectively against beneficial insects, a factor of relatively negligible importance in the case of the older insecticides in use. In countries like Ceylon this is specially significant, as a large number of crop pests are normally kept at negligible population levels through the activities of insect parasites and predators. It would be essential therefore to watch the effects produced by the use of these insecticides on parasites and predators in any particular case. Honey bees would be also adversely affected by the application of these insecticides unless these applications are so timed as to avoid periods of major flowering, especially on crops regularly visited by bees.

The eventual economic efficiency of these insecticides can, therefore, only be properly ascertained after extensive and repeated field trials carried out in relation to specific pests in their natural environment. The preliminary trials carried out have shown, however, that they can be recommended for use on a restricted scale under special circumstances such as, minor pest epidemics in restricted areas where the natural balance has already been upset, and the sudden appearances of a pest in relatively large numbers in small or domestic gardens. Effective applications in this connexion, which can be recommended on the basis of the tests carried out, are, the use of dusts containing from 3–5 per cent. of the active ingredient in weekly applica-

tions, or, the use of aqueous sprays containing ·1–·5 per cent. of the active ingredient applied twice weekly. Dusts should be applied only under relatively dry conditions. It would also not be generally advisable to continue the application of the insecticides for periods longer than a fortnight at one stretch.

It may also be said that these two insecticides have good possibilities with regard to the control of the majority of serious economic pests of this country, for which at present the degree of control that can be achieved through insecticidal or other means is inadequate or uneconomic. In such cases, however, extensive trials will have to be carried out and detailed schedules of application obtained in connection with each specific pest.

At present Gammexane appears to be superior in toxic value to DDT for insects on plants and therefore the more promising of the two insecticides for agricultiral use, but much may still depend on the ability of manufacturers to produce water miscible sprays with high insecticidal contents.

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TABLE I.

Effect of Gammexane (666) and DDT on Stored Grain.

Grain.	Initial Infestation.	Treatment.	Later Infestation. After 3 months. Treated.	After 3 months. Control.	After 6 months. Treated.	After 6 months. Control.
Green gram	5%	·05% 666	6%	19%	4%	25%
Cowpea	6%	·025% 666	6%	12%	7%	56%
Wheat	8%	·05% 666	9%	42%	12%	64%
Wheat	8%	·012% DDT	7%	42%	9%	64%
Wheat	10%	·025% 666	11%	35%	12%	52%
Wheat	10%	·012% DDT	10%	35%	12%	52%

TABLE II

Effect of Gammexane and DDT on Various Insects.

(Insecticides applied both on plant surface and sides of cage).

Insect.	Insecticide Nature and Strength.	Period Exposure.	Mortality noted up to 48 hours after introduction. Day of application. Per Cent.	5 days later. Per Cent.	10 days later. Per Cent.	14 days later. Per Cent.
Leptocorisa varicornis	3 per cent. 666 Dust	2 hrs.	100	100	100	100
	3 per cent. 666 Dust	15 min.	100	60	40	0
	3 per cent. DDT Dust	2 hrs.	100	100	100	100
	3 per cent. DDT Dust	15 min.	100	20	20	0
	·5 per cent. DDT Spray	2 hrs.	100	0	—	—
	·1 per cent. DDT Spray	6 hrs.	100	40	0	—
Dacus cucurbitae	3 per cent. 666 Dust	2 hrs.	100	100	100	—
	3 per cent. 666 Dust	15 min.	100	100	20	—
	3 per cent. DDT Dust	2 hrs.	100	40	20	—
	3 per cent. DDT Dust	15 min.	100	100	20	—
	·1 per cent. DDT Spray	6 hrs.	100	60	0	—
Aularches miliaris	1 per cent. 666 Dust	2 hrs.	100	—	—	—
	3 per cent. 666 Dust	2 hrs.	100	100	—	—
	3 per cent. DDT Dust	2 hrs.	0	—	—	—
	·5 per cent. DDT Spray	24 hrs.	0	—	—	—

10 insects were used for each test ; a control was kept in all cases and percentage mortality was determined by taking the numbers alive at the end of the test as determining numbers with the numbers alive in control as maximum.

Table III.

Effect of Gammexane and DDT on Various Insects.

(Insecticides applied on plant surfaces only to which insects were continuously exposed.)

Insect.	Insecticide Nature and Strength.	Phytocidal effect on host plant.	Mortality noted up to 48 hours after introduction. Day of application. Per Cent.	5 days later. Per Cent.	10 days later. Per Cent.
Leptocorisa varicornis	3 per cent. 666 Dust	None	100	100	10
	3 per cent. DDT Dust	None	100	80	0
	·1 per cent. DDT Spray	None	40	40	0
Dacus cucurbitae	3 per cent. 666 Dust	Slight scorching of tender foliage	100	100	40
	3 per cent. DDT Dust	do.	100	40	0
	·1 per cent. DDT Spray	None	100	0	0
Aularches miliaris	3 per cent. 666 Dust	None	100	100	20
	3 per cent. DDT Dust	None	800	0	0
	·1 per cent. DDT Spray	None	30	20	0
	·5 per cent. DDT Spray (emulsion)	Slight scorching	60	10	0
Prodenia litura	3 per cent. 666 Dust	None	100	80	—
	3 per cent. DDT Dust	None	100	60	—
	·1 per cent. DDT Spray	None	80	0	—
Agromyza phaseoli	3 per cent. 666 Dust	Slight scorching of tender foliage	100	100	100
	3 per cent. DDT Dust	None	100	100	60
	·1 per cent. DDT Spray	Slight scorching of tender foliage	100	80	20

10 insects were used for each test and treated plants retained in cage till observations were over ; a control was kept in all cases and percentage mortality determined by taking the numbers alive at the end of test as the determining numbers with the numbers alive in control as maximum.

THE PERFORMANCE OF SOME IMPORTED VARIETIES OF AVOCADO IN CEYLON

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ABSTRACT

THE avocado, which is native to Central America and Mexico, is a fruit of high nutritive value. It should find an important place in the diet of our people since it is rich in minerals, fats, proteins and other health promoting substances.

The Common avocado which is grown locally from seed is not of high quality compared to the grafted varieties imported from California and Florida. These imported varieties fail to grow well on their own stocks but exhibit remarkable vigour of growth when worked on the local seedling stock. Of the varieties under trial Gottfried and St. Anne " take " more readily than Pollock and Puebla when budded. The Gottfried variety is the first to come into season in May and is followed by Puebla, Pollock and St. Anne which is a late variety maturing in August to September.

The avocado fails to grow in the dry zone ; it is essentially a fruit for the wet zone where it grows best in the mid-country.

INTRODUCTION

The avocado, which is a member of the laurel family, is native to Central America and Mexico where it has been grown for centuries as an important food crop. It serves in some measure as a meat substitute in the diet of the native inhabitants whose favourite meal consists of avocado and corn cakes.

Popenoe (4) records the presence of wild avocadoes in remote parts of tropical America. These he regards as prototypes of some of the horticultural races that had spread from very early times to other regions around the Carribean and the Northern Andes of South America.

The most striking development in commercial culture of avocado has taken place in Florida (5) and California (2) where thriving industries have been established by large co-operative organizations. The avocado was probably brought to Florida by the early settlers although the recorded date of introduction was in 1883 when Henry Perrine sent trees from Mexico to be planted on his land south of Miami. It was introduced successfully into California in 1871. Since then it has been established in parts of South Africa and Australia, where production is on the increase because of its high nutritive value.

The date of introduction into Ceylon of the local seedling avocado which is of the West Indian type is not known ; but the available records indicate that budgrafts of Lyon, Puebla and Dutton varieties of avocado were established successfully in the Royal Botanic Gardens, Peradeniya, from a collection of popular varieties imported on May 12, 1927, from Armstrong nurseries, California. Further successful introductions were made of Gottfried, Trapp and Pollock from the United States Department of Agriculture, Washington, and of St. Anne from the Department of Agriculture, Trinidad B.W.I. Budwood of Winslowson and Collinson imported from Washington proved a failure, but seeds of Puebla and Harman varieties received from the California Avocado Growers' Association on December 20, 1932, were germinated satisfactorily and planted out in the Gardens. One budgraft of Fuerte, which is the leading variety in California with the highest oil content of 30 per cent. was brought from there by the writer in April, 1940, and has now been successfully multiplied on local avocado stocks.

HORTICULTURAL RACES

Most of the cultivated varieties of avocado belong to three horticultural races, the Mexican and Gautamalan from the highlands, and the West Indian from the lowlands. The Mexican which is considered by some as a distinct species *Persea drymifolia* Mez. is easily distinguishable from the other two classified as *Persea Americana* Mill. by the characteristic anise odour of the crushed leaves. The fruits are small to medium in size, smooth and thin skinned with a rich nutty flavour. The fruits of the Guatamalan race mature during winter and spring, and have a woody granular skin of comparative thickness ; while those of the West Indian race mature during summer and autumn and have a skin of leathery texture and medium thickness. The fruits of these races vary in colour from green to maroon or dark purple, and in shape from round to oval or pear shape. In Ceylon seedling trees of the local West Indian avocado grow well in the mid-country wet zone at elevations between 1,000 and 3,500 feet on well drained soils and have a short ripening season from July to September. They do not thrive in the low-country dry zone. The fruits are green in colour and not of the best quality and flavour compared to some of the imported varieties under trial.

Of these imported varieties Pollock, St. Anne, and Trapp belong to the West Indian race, Puebla and Harman are Mexican, Dutton and Lyon are Guatamalan, Gottfried is believed to be a natural Mexican-West Indian cross, and Fuerte a natural Mexican-Guatamalan cross. The fruits of Puebla, Dutton, and Gottfried turn purple as they ripen but the others remain green. The Pollock variety produces the largest fruits, each weighing $1\frac{1}{2}$ to 2 lb., while those of St. Anne which are second in size are more distinctly pear shaped.

The following are some of the desirable characteristics to be taken into account in the selection of varieties for planting :—

(1) Hardy and vigorous habit of growth.
(2) Heavy and regular bearing habit.
(3) Season of maturity when market demand is high.
(4) Uniformity in size and shape of fruit, medium size being preferred.

(5) Smooth and creamy pulp with rich nutty flavour and free from fibre.
(6) Oil content at least 6 per cent, but preferably higher.
(7) Skin smooth, tough and sufficiently thick to resist fruit fly attack.
(8) Seed small, fitting tight in cavity with seed coat firmly adhering to it.

DESIGN OF THE EXPERIMENT

This paper records the progress of the preliminary trials set down on a section of the Horticultural nursery at Peradeniya with four varieties of avocado, Gottfried, Puebla, Pollock and St. Anne budgrafted on the local West Indian avocado stock. The randomized block lay out with single tree plots was used owing to limitation of space in the nursery. The varietal treatments were replicated five times. Bud-grafts of five other varieties Fuerte, Lyon, Dutton, Trapp and R. B. G. Purple hybrid, a local purple-fruited selection which tends to fruit during the off seoasn, were planted outside the border rows for observation.

Budwood was taken from the following single parent trees of each variety and budded in the nursery on seedling stocks of uniform size in May, 1941 :—

Puebla tree No. EC 2 Royal Botanic Gardens, Peradeniya.
Gottfried tree No. EC 12 Royal Botanic Gardens, Peradeniya.
Pollock tree No. F8/4 Experiment Station, Peradeniya.
St. Anne tree No. F8/17 Experiment Station, Peradeniya.

The method of budding used was a variation of the modified Forkert method (1). A transverse incision was made on the stock and the bark was peeled downward as well as slightly upward to produce two flaps, one smaller than the other. The scion bud was inserted under the flaps and held firmly in position. The lower flap was trimmed to expose the " eye " of the bud and the " H " shaped panel thus formed was tied firmly with budding tape.

With Gottfried and St. Anne the percentage of successful bud " take " was 92 per cent. and 93 per cent. respectively, but for Pollock it was 87 per cent. and for Puebla 66 per cent. Even in subsequent attempts at budding with selected budwood Pollock and Puebla failed to shoot out so readily as Gottfried and St. Anne. Cleft grafting gave satisfactory results on clear days, but was a complete failure during wet weather owing to the incidence of anthracnose which killed the scion.

The budgrafts selected for the trials were planted in the permanent site on December 2, 1941, and records of height, girth of scion and stock at fixed points 6 cms. above and below the bud union were taken annually. The average measurements taken on July 22, 1946, are given in the following table :—

	Gottfried.	Puebla.	Pollock.	St. Anne.
Girth of Scion in Cms.	52·46	45·66	38·96	42·74
Girth of Stock in Cms.	59·94	55·78	45·92	53·04

There is no significant difference between the varieties in either-scion or stock girth. The analysis of variance of stock and scion girth is given in Appendix I.

None of the plants in the trial exhibited symptoms of stock-scion incompatibility in habit of growth which was normal. Both Gottfried and St. Anne were more vigorous than the others in the early stages.

The Pollock variety was the first to come into flower two years after planting, but was not allowed to set fruit so early. During the next two years all the varieties except St. Anne came into flower, but hardly any set fruit.

This year all the varieties were in fruit although it is too early yet for them to bear normal crops. Gottfried was the first to flower at the end of last November and the fruits were harvested in May. It was followed by Puebla which came into flower slightly earlier than Pollock in January. The fruits of Puebla ripened during May to June, and those of Pollock from June to August. St. Anne was the last to come into flower in February, and the fruits began to mature during September. Most of them were badly attacked by anthracnose probably owing to the abnormal wet weather experienced during the month. All the varieties except St. Anne came into flower again in August and it remains to be seen whether it would result in the production of a second crop early next year. The other varieties planted outside the border rows in 1944 are too young to come into bearing, but they have all grown well on the local stock.

DISCUSSION

It would be seen that there is so far no evidence of incompatibility between any of these varieties and the West Indian stock which is acclimatised to local conditions in the wet zone. Seed of the local variety is available in plenty during the season, and seedling stock could be raised on a commercial scale with little difficulty.

Most of the trees in the trial have just come into bearing and it is premature to compare the yields of the different varieties. But their period of bearing is of considerable interest because of the possibilities of extending the fruiting season. In Florida and California where commercial culture of avocado has greatly advanced the aim of the grower is to produce fruits all the year round by the use of early, late and mid-season varieties. The remarkable progress made in this direction has according to Popenoe (4) aroused the interest of the growers in the Carribean to the possibility of extending the short ripening season of their native West Indian seedling by planting Guatamalans and Guatamalan-West Indian crosses. A similar situation exists in this country where the local variety is in season only from July to early September. Of the imported varieties Gottfried tends to be early while St. Anne is late. When more is known of the performance of the others it would be possible to recommend a suitable selection of varieties that would materially extend the present avocado season.

NUTRITIVE VALUE OF AVOCADO

The avocado is a fruit of high nutritive value. No other fresh fruit is so rich in fat, protein, minerals and vitamins A and B. The fat content may vary from 2 to 30 per cent. of the fresh fruit according to the variety, but the quality of the fruit is not dependant on it since some varieties such as the Pollock with low fat content are highly esteemed for their flavour. Because of its high calorific value and very low carbohydrate content the avocado makes an admirable food for diabetic cases.

The fruit is highly relished in America, where it is often served " on the half-shell " as a salad with celery, lettuce, tomato, onion and French dressing or Mayonnaise. Some people prefer to eat it plain, others with sugar and cream or pepper and salt. It makes an excellent sandwich spread when mashed and seasoned with tomato catsup, lemon juice and vinegar or onion. Cooking causes the fruit to develop a very bitter flavour owing to the presence of a tannin, but it could be diced and added to vegetable soup, consommé or omelette just before serving.

The following are some recipés from Hawaii (3) which should help to make people in this country cultivate a taste for the fruit :—

AVOCADO COCKTAIL (6 servings)

4½ cups diced avocado
1 cup tomato cat-sup
1 tea spoonful finely chopped onions or juice
1½ table spoonful lemon juice
1½ tea spoonful Worcestershire sauce
1½ tea spoonful salt

Sprinkle salt over the avocado and chill. Combine other ingredients, chill and pour over avocado just before serving.

AVOCADO PAPAYA COCKTAIL (6 servings)

3 cups diced avocado
1½ cups diced ripe papaya
½ cup tomato cat-sup
3 table spoonful cream

Add cream and catsup when ready to serve and pour over chilled diced fruit.

AVOCADO PINEAPPLE SALAD (6 servings)

6 slices fresh pineapple
2 cups avocado slices
⅓ cup mashed avocado pulp
⅔ cup mayonnaise
2 table spoonful lime juice

Place pineapple and avocado slices on lettuce leaves. Make a dressing of the other ingredients, chill and pour over salad.

CURRIED AVOCADO (6 servings)

4 table spoonful butter
5 table spoonful flour
2 cups milk
1½ tea spoonful salt
2 to 3 tea spoonful curry powder
2 cups diced avocado

Melt butter, add flour and stir to make a smooth paste ; stir in milk gradually, cooking until the mixture thickens. Season with curry powder, salt and pepper. Remove from fire and just before serving add avocado. Serve with cooked rice and mango chutney.

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APPENDIX I.

Avocado Trial—Peradeniya.

Analysis of Variance of Scion Girth.

	DF.	SS.	Variance.	F.	5 % Point.
Blocks	4	6077·00	1519·3		
Treatment	3	48834·00	16278·00	3·03	3·49
Error	12	64464·00	5372·00		
Total	19	119375·00			

Analysis of Variance of Stock .Girth.

	DF.	SS.	Variance.	F.	5 % Point.
Blocks	4	25664·0	6416·0		
Treatments	3	56435·0	18811·7	3·08	3·49
Error	12	73232·0	6102·7		
Total	19	155331·0			

RAIN CLOUDS AND RAIN IN CEYLON

(*Continuation*)

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6. TYPES OF RAIN IN CEYLON

Rain may be classified according to its cause into the following types :—

(1) *Convectional Rain*, caused by the ascent of warm moist air,
(2) *Orographical Rain*, caused by the ascent of moist air over mountain ranges or high hills,
(3) *Frontal Rain*, caused by the ascent of warm moist air over colder air, and
(4) *Depressional Rain*, caused by the ascent of moist air at an area of low pressure.

Convectional Rain may be subdivided into rain due to convection during the day and during the night. I shall give in more detail the cause of each type and some of their characteristics.

Convectional Rain formed by Day.—During the day the land absorbs solar radiation and warms up. It then warms the air above it, which ascends and forms cloud and rain when the air is sufficiently moist. This convection is very active on bright sunny days when winds are light.

Because the sea does not warm up appreciably by absorption of solar radiation, convection here takes place in a different way. The moist air over the sea absorbs a small part of the solar radiation, becomes warmer and ascends. This ascent, however, is able to form clouds and rain only when the air is very moist and nearly unstable—a condition greatly favouring ascent.

Convection over the Island produces clouds of the type shown in figure VIII (*a*), which give showers and thundershowers inland between noon and evening. When sea breeze is marked, the clouds concentrate as shown in figure VIII (*b*) and give fairly heavy rain inland. When there is appreciable wind in the upper levels in any direction, the cloud and rain travel towards the coast in that direction. When convection is vigorous and thunder-clouds form inland and develop large hoods of alto-stratus cloud as in figure VIII (*c*), the rain travels towards the coast as a thundersquall while the sheet of alto-stratus gives drizzle and rain accompanied by a little thunder in regions outside the path of the thundersquall.

When convection over the sea forms rainclouds and winds are favourable, these rainclouds are carried across the coast and give showers, as shown in figure IX (*a*), or rainsqualls, as in figure IX (*b*) and (*c*), in the coastal areas between noon and evening. The larger of these rainsqualls are sometimes accompanied by a little thunder.

(a) SCATTERED SHOWERS

(b) THUNDERSTORM INLAND

(C) THUNDERSTORM INLAND, WITH THUNDERSQUALL

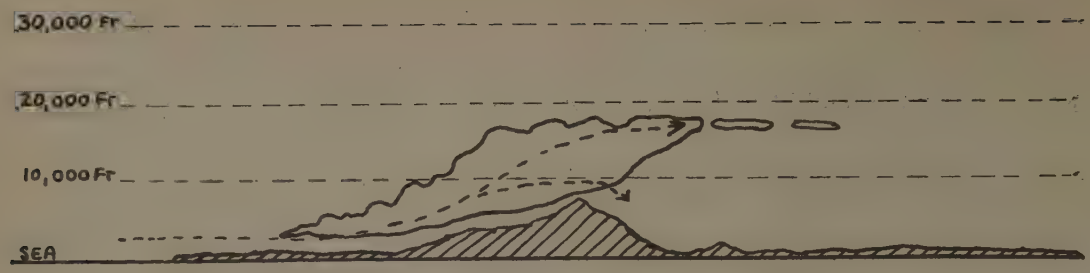
FIGURE VIII – CONVECTION RAINCLOUDS OVER LAND

Printed by Survey Dept., Ceylon.
12 . 8 . 47 .

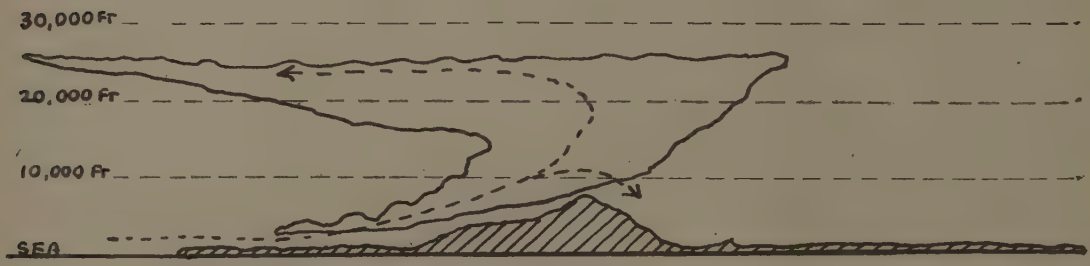
(c) LARGE RAINSQUALLS

FIGURE IX – CONVECTION RAINCLOUDS OVER SEA

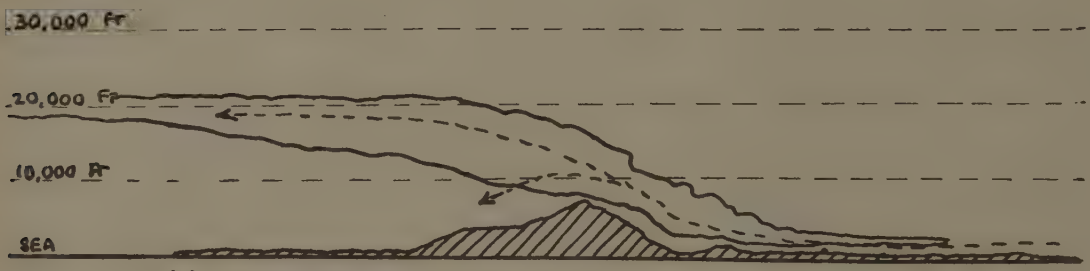
Printed by Survey Dept., Ceylon.
12. 8. 47 .



(a) PURELY OROGRAPHICAL RAINCLOUD.



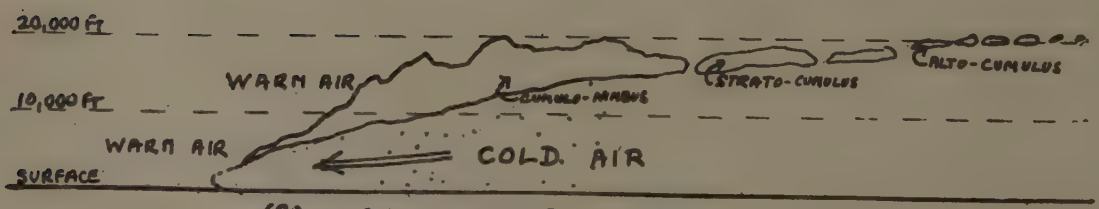
(b) HOOD CLOUD BY CONTINUED ASCENT — SOUTH-WEST MONSOON



(c) HOOD CLOUD BY CONTINUED ASCENT — NORTH-EAST MONSOON

FIGURE X - OROGRAPHICAL RAINCLOUDS

Printed by Survey Dept., Ceylon.
12. 8. 47.



(b) AT A COLD FRONT

FIGURE XI - FRONTAL RAINCLOUDS

Printed by Survey Dept., Ceylon.
12. 8. 47.

Convectional Rain formed by Night.—During the night the sea and the moist air over it cool very slowly while the air at higher levels cools faster by radiation. The warmer air below then ascends and forms cloud and rain when it is moist, warm and nearly unstable. When winds are favourable these rainclouds too, are carried across the coast and give showers or rainsqualls, as shown in figure IX, in the coastal regions before and after dawn. Here again, the larger rainsqualls are sometimes accompanied by lightning and thunder.

Over land, convection is not active at night because the land cools rapidly by radiation. However, convection started over land during the day continues and gives rain at night, or convection taking place over the sea at night is carried over land and gives rain in the early hours of the morning.

Orographical Rain.—When winds cause moist air to ascend over mountain ranges or high hills, cloud and rain are formed. The ascent alone of moist air over the hills and mountain ranges in the centre of Ceylon, which are mainly below 7,000 feet, would produce only a steady drizzle on their windward slopes, as shown in figure X (*a*). Other factors, however, contribute to produce the heavier and more widespread rain we experience when steady moist winds blow across the Island. Firstly, convection commences cloud formation and rain before the air reaches the hills—often over the sea—thus giving rain between the coast and the hills, and also increasing the rain on the hill-sides by helping the formation of larger drops. Secondly, the clouds formed by ascent over the hills or mountains continue to ascend further and produce heavier rain. When the winds are strong the clouds often ascend to even three times the height of the mountains. The cloud is then carried horizontally as a sheet of alto-stratus which gives overcast skies over a large area and sometimes drizzle or rain as shown in figure X (*b*) and (*c*).

Orographical rain occurs at all times of the day, and varies in intensity because of the convectional factor in it.

Frontal Rain.—When warm moist air and colder air meet or flow side by side, either the warm air rises over the colder, or the colder air flows under the warmer and pushes it up. In either case cloud and rain form in the rising warm air. The boundaries at the ground where the air masses meet are called " fronts ", in the former case a " warm front " as shown in figure XI (*a*) and in the latter a " cold front " as in figure XI (*b*).

Because temperatures over the Island vary a great deal owing to several causes and data are lacking, it is rarely possible to identify fronts in our neighbourhood. Frontal rain is widespread and generally continuous, but owing to convectional effects it varies in intensity at different times of the day.

Depressional Rain.—The term " depressional rain " is not restricted here to rain from depressions only but is extended to include all rain of the same type and from a similar cause—an " area of low pressure ". At an area of low pressure winds are usually light and the air ascending and forming cloud and rain. Often, however, when there is rain of this type it is not possible to identify an area of low pressure on our surface pressure charts, but I have frequently found evidence of it at a higher level from the directions of the winds there. Even when a depression is forming and there is heavy

rain, no marked area of low pressure may be evident at the ground at first. It is some time later that winds strengthen and pressure falls at the central area.

When there are rain clouds giving light, moderate or heavy rain almost continuously with no appreciable wind it is usually termed "unsettled weather" and is illustrated in figure XII (*a*). When the clouds extend to a great height and give rain with thunder at all times of the day and night it is called "thundery weather" and is illustrated in figure XII (*b*). Unsettled weather or thundery weather with heavy rain often develops stronger winds and intensifies into "depressions" and "cyclonic storms", the cloud formation of which is shown in figure XII (*c*).

The thunderclouds at the more intense areas of low pressure, particularly depressions, usually develop a hood of alto-stratus cloud extending in some westerly direction and giving widespread drizzle and rain. Because despressions to the north-east and north draw moist south-westerly winds across the Island, they generally give fairly heavy rain here. Depressions to the north-west or west, if sufficiently far off not to affect the weather over the Island directly, usually give fair weather.

Rain at areas of low pressure too, is more or less continuous but its intensity is affected by convection.

7. THE SEASONAL RAINS OF CEYLON

There are four main seasons in Ceylon—the First Intermonsoon Season, the South-west Monsoon, the Second Intermonsoon Season and the North-east Monsoon. In addition there are characteristic spells of heavy rain such as are experienced about the time of the setting in of the South-west Monsoon (popularly known as the "bursting of the monsoon") and during the setting in of the North-east Monsoon. However, a fairly large part of the Island's rainfall, almost throughout the year, is due to "unsettled weather" and "thundery weather" which occasionally develop into areas of low pressure, depressions and cyclonic storms.

The seasons vary in duration from year to year. They do not have well-defined beginnings and endings but usually merge one into another. For example, there might be an advance of the south-west monsoon followed by a return to local thunderstorms of the intermonsoon season. Further, the rain of any season is often of more than one type, while the rain at any time may be the result of two or more causes working conjointly. For instance, convection is active to some extent almost every day and adds its effect to rain from other causes.

The First Intermonsoon Season (*March to mid-May*).—During this season winds are often light to a great height and heating of the land and sea by the sun, which is nearly overhead, is at a maximum—conditions most favourable for convection. During the latter part of the season there are warm light to moderate westerly winds which are shallow.

The rain of this season is of the following types :—

(*a*) *Convectional Rain by Day.*—When winds are light to a great height and the air sufficiently moist, convection takes place over land and gives scattered showers, thundershowers, or thundersqualls, according to the intensity of convection

and the development of sea breeze. Thundershowers and thundersqualls are most common in April and usually travel from the inland hills to the west coast.

(*b*) *Convectional Rain by Night.*—During the night when the sea is warm and the air sufficiently moist and nearly unstable, convection takes place over the sea forming rainclouds by early morning. During April and May, when westerly winds prevail these rainclouds are carried across the south-west coast giving showers in these coastal regions about dawn.

(*c*) *Depressional Rain.*—Areas of low pressure form near the Island causing "unsettled weather" or "thundery weather" particularly in May. They occasionally develop into depressions and give heavy continuous and widespread rain.

Characteristic Spells of Heavy Rain in May (*bursting of the Monsoon ?*).—During May it is usual to have at least one spell of fairly widespread rain, particularly heavy in the south-west quarter of the Island. Though these spells of rain last for only a few days, yet they account for a good proportion of the total rainfall for the month. The rain falls from heavy thunderclouds spread over the land and sea, both during the day and the night. The clouds suggest that the air is very unstable and the rain is usually of the depressional type and the result of "unsettled weather" conditions. The "unsettled weather" sometimes develops into an area of low pressure or a depression which induces moderate to strong south-westerly winds which are more in evidence in the south-west quarter.

The south-west monsoon too, generally begins to establish itself near Ceylon some time in May. It sometimes becomes evident about the same time as one of these spells of heavy rain and gives the impression that the latter was due to the setting in (or bursting as most people call it) of the south-west monsoon.

On some occasions after the monsoon has set in quietly, there is a rapid strengthening of moonsoon accompanied by fairly heavy rain almost confined to the south-west quarter. This too, is often presumed to be the bursting of the monsoon.

The South-west Monsoon (May to September).—The south-west monsoon near Ceylon is not a steady wind even when well established. It varies in strength from weak to strong, becoming vigorous at times. It also varies a great deal in depth, often extending to over 15,000 feet. In direction, it varies from south-south-west to west, or even a little north of west. Rain is more likely when the direction of the wind is nearer south than west and also when the monsoon is deep. The monsoon is generally strong in the latter half of May and in June and July, when it gives most of its rain. By September convection is again very active and a major cause of rain.

Rain during the south-west monsoon is of the following types :—

(*a*) *Orographical Rain.*—Ascent of the moist monsoon winds over the hills and mountains in the central part of the Island gives orographical rain on their south-western slopes.

With strong wind, owing to the development of a hood effect by continued ascent, the rain spreads towards the south-west coast and towards the other side of the mountain ranges.

(*b*) *Convection Rain by Day.*—Convection over the land adds its effect to orographical rain when it is not too cloudy, particularly with weak or moderate monsoon. When the monsoon is weak or moderate convection takes place on the east side of the Island too. The convectional rainclouds there are fed by sea breeze from the east coast and give afternoon or evening thunderstorms on that side. Convection by day is active over the sea when the monsoon winds are moist and nearly unstable. The rainclouds formed are carried across the south-west coast giving showers and rainsqualls between noon and evening.

(*c*) *Convection Rain by Night.*—Convection is often active over the sea at night when the monsoon winds are moist and nearly unstable. The rainclouds formed are carried across the south-west coast by the monsoon winds, giving showers and rainsqualls before and after dawn. Sometimes these convectional rainclouds formed over the sea are carried to the land, continue growing, and become thunderclouds.

(*d*) *Depressional Rain.*—Areas of low pressure form during May, giving fairly heavy widespread rain and sometimes developing into depressions. During June they are hardly noticeable, while from July onwards they form again giving spells of fairly heavy rain followed by strengthening of the monsoon. In September they occasionally develop into depressions.

Corresponding to the bad weather associated with the advancing monsoon, the retreating monsoon too, sometimes gives a spell of thunderstorms some time in October. This does not occur regularly and is not of much violence.

The Second Intermonsoon Season (September to November).—During this season too, winds are generally light and heating of the land and sea by the sun is appreciable—conditions most favourable for convection. However, unlike the other intermonsoon period, areas of low pressure are frequent and more active, and helped by convection and possibly frontal effects they make this the rainiest season of the year for the Island as a whole. This intermonsoon season gives more rain to the north and east of the Island than the other does.

The rain is of the following types.—

(*a*) *Depressional Rain.*—Areas of low pressure occur frequently and give spells of "unsettled weather" and "thundery weather", which sometimes develop into depressions near the Island. The rain is rather heavy and widespread, accompanied by thunder and often lasting several days.

(*b*) *Convectional Rain by Day.*—Convection by day over the land is not so marked as in the first intermonsoon season. It, however, adds its effect to other types of rain, causing an appreciable increase in the afternoon and evening.

(*c*) *Convection Rain by Night.*—Convection by night takes place over the sea, particularly to the east of the Island where it forms rainclouds and thunderclouds. The hoods of these thunderclouds often extend to the western side of the Island and give rain there too, especially when associated with areas of low pressure.

Setting in of the North-East Monsoon (November and December).—The setting in of the north-east monsoon is a more protracted process than that of the south-west monsoon. During November and early December the north-east monsoon begins to assert itself. Cold northerly to easterly winds, from some northerly source, advance southwards or south-westwards over the Island and cause the moist stagnant air to ascend over it. This *frontal effect*, aided to a great extent by *convection by day* over the land, causes fairly heavy widespread rain, particularly in the east and north of the Island. With moderate north-easterly winds, *convection by day* over the land causes thunderstorms in the north-west and west of the Island. Sea breeze is then active by noon, causing the north-east wind to swing round to north-west on the west coast. Later on, an afternoon or evening thundersquall travels on the west side of the Island from a north-easterly direction. *Convection at night* sometimes takes place over the sea, particularly on the east side of the Island, and may be associated with *areas of low pressure* which sometimes develop into depressions. Depressions to the east or north-east of the Island generally cause moist south-westerly winds to be drawn over the Island and give plenty of rain. Some depressions however induce cold northerly winds which give little rain though skies may be overcast. Usually by the end of December, the cold northerly winds having swept away the moist stagnant air, give a spell of crisp clear weather. This is not the real north-east monsoon which is a rain-bearing wind from an easterly source and gives mainly orographical rain.

The North-East Monsoon (December to March).—The north-east monsoon near Ceylon is not as persistent a wind as the south-west monsoon. It varies in strength from weak to strong, in direction from north to south of east, and also in depth. Northerly winds are usually cold and dry, while easterly winds are usually warm and moist in comparison. The north-east monsoon is generally strong at the end of December and in January, in February it is moderate and gives little rain, while in March it is generally weak and allows local convection by day to form thunderclouds inland.

Rain during the north-east monsoon is of the following types :—

(*a*) *Orographical Rain.*—Ascent of moist monsoon winds over the central mountains and hills gives orographical rain on their north-eastern slopes. With strong monsoon continued

ascent causes a hood effect to spread over the western and south-western part of the Island and give drizzle and light rain there.

(*b*) *Convectional Rain by Day.*—Convection by day over the land on the east side of the Island aids orographical rain, when skies are not too clouded. When the monsoon is moderate convection takes place in the north-west and west giving evening thundershowers and thundersqualls there. When the monsoon is weak convection causes thundershowers close to and among the inland hills. Convection by day over the sea causes showers and rainsqualls which are carried across the north-east and east coast by the monsoon winds between noon and evening.

(*c*) *Convectional Rain by Night.*—Convection at night takes place over the sea when the monsoon winds are moist and nearly unstable, and forms rainclouds. These rainclouds are carried across the north-east and east coast giving showers and rainsqualls in the morning.

(*d*) *Depressional Rain.*—Areas of low pressure often travel with the monsoon stream and gives spells of unsettled weather with rain. On a few occasions they have developed into depressions and given heavier rain.

FORECASTING RAIN IN CEYLON

It is perhaps fitting to conclude with the problem of forecasting rain. Forecasting is generally done with the help of weather charts, drawn at frequent intervals from observations reported from a wide network of stations. These charts show centres of low and high pressure, the development and movement of which are followed closely. From collected data and experience, certain probabilities of cloudiness, rain, wind, and temperature have been associated with these centres of pressure, their movement, and the various patterns made by them, and from these probabilities forecasts are made. In several countries the " fronts " along which " air masses " from various sources and with different properties meet, are identified and also used for forecasting. Additional help is obtained from charts showing upper winds, temperatures and humidities in the upper air, and other data.

In Ceylon, however, our weather charts are prepared only once a day and cover such a small area that they rarely show centres of low or high pressure. For the same reason, partly, " air masses " and " fronts " cannot be identified and used for forecasting. Upper wind observations are normally made at Colombo and Mannar, but because of the frequent loss of balloons in low cloud, this information is very scanty when most desired. We are therefore compelled to use simple indications, such as the presence of certain types of cloud and variations of temperature and humidity at upcountry stations. But these often do not give sufficient warning of weather changes which frequently take place over the Island overnight.

Our Ceylon weather service is in this state of backwardness and insufficiency due as much to the lack of sufficient trained staff and facilities for research, as to the lack of equipment. The coming development of Civil Aviation in Ceylon will soon demand dependable weather forecasts. For this, more frequent charts from observations over a wider area and taken by better trained observers will be necessary. More information of conditions in the upper air will also be needed. Another very important necessity, however, is an intense study of weather processes taking place in our neighbourhood, which are peculiar to our latitude and of which we still know too little. When these requirements are satisfied we should not only be in a position to give reasonably accurate forecasts for aviation, but we should also be of greater usefulness to agriculturists and others whose interests are connected with the weather.

My thanks are due to Dr. D. T. E. Dassanayake, Superintendent of the Colombo Observatory, for kindly reviewing this article and for many valuable suggestions.

GARCINIA IN CEYLON

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GARCINIA, a large genus of trees belonging to the family *Guttiferae*, is native to the Tropics of the Old World. The genus is represented in Ceylon by five indigenous species, viz.—

G. Morella Desrouss. *Kana-goraka, Gokatu, Kokatiya*—S.
G. Cambogia Desrouss. *Goraka*—S.
G. Echinocarpa Thw. *Madol*—S.
G. terpnophylla Thw. *Kokatiya*—S.
G. spicata Hk. f. *Ela-gokatu, Gonapana*—S.

All these species (except *G. echinocarpa* which is confined to the hills) occur in the moist low country. *G. mangostana* Linn., the mangosteen, is a native of Malaya, and had been introduced into Ceylon about the year 1800.

The two species, *G. Morella* and *G. Cambogia*, are of considerable economic value, and form the subject of this paper. *G. Morella* has a wide range of medicinal uses. *G. Cambogia* is employed extensively as a sour relish and in the curing of fish. *G. Morella* is a small, slow-growing, pyramidal, smooth-barked tree. *G. Cambogia* is a rough-barked, medium-sized tree with a rounded head and drooping branches. The flowers of both species are unisexual and dioecious. The fruit of *G. Morella* is small and ungrooved. The large, green, fluted fruit of *G. Cambogia* ripens into either an orange-yellow (*ela-goraka*) or a dull red (*rath-goraka*). The grooving of the fruit provides a simple specific distinction. Both species are moderately common in the wet forests of Western Ceylon from sea level to 2,000 ft. ; *G. Cambogia* is more abundant. *G. Morella* blooms in May, and *G. Cambogia* during the period February to March.

G. Morella yields commercial gamboge. The Siamese product comes from a closely related species, viz. *G. Hanburyi*. The Ceylon and Siamese species were at one time erroneously considered identical. Trees over 12 years old are tapped for gamboge in wet weather by means of a spiral incision on the trunk ; the yellow exudate is collected in bamboo receptacles. Gamboge was the yellow pigment used by the old Sinhalese fresco painters ; it was itself a *valicciya*, and unlike other paints did not need the superimposition of a varnish. It is a dye for the robes of Buddhist monks. The golden ink used by the Siamese for writing on black paper consists of gamboge. It makes gold varnishes and gold lacquers. Gamboge paint is a water emulsion. The chief components of the resin are cambogic acid and a gum similar to that of the Acacias.

In primitive rituals, *G. Morella* filled a place comparable to the mistletoe of the Druids. It is, however, on account of its immense medicinal value that it is prized by the Ceylonese. The literature of Ayurveda teems with references to the medicinal properties of various parts of the plant. King Buddhadasa's compilation "*SARARTHA SANGRAHAWA*" for instance, prescribes *goraka* for ailments as varied as rheumatism, rickets and enlargement of the spleen. *Goraka* is one of the five acid fruits specified in Ayurveda ; the other four belong to the genus *Citrus*, viz., lime, orange, *nas-naran and gada-thehi.*

Particularly noteworthy is the widespread use of the bark and tender leaves in the treatment of fractures. An external application of a leaf *mellum* promotes the setting of bones. Material used in external application is pounded with common salt. The bark and leaves are also applied to sprains, contusions and swellings. In combination with other drugs, the bark and leaves are used in the treatment of hernia. Oil expressed from the bark is applied to ulcers.

A gargle consisting of a water extract of the root prevents decaying gums. Chewing the aril that surrounds the seeds has the same effect.

The astringent properties of the fruit round pericarp are valued in medicine. The dried rind is the chief ingredient of decoctions given to women after confinement. A water extract of the rind remedies flatulence and nausea. Carbuncles, catarrh, cancer, consumption and skin diseases are reputed to respond to treatment with preparations from the rind.

The resin tapped from the bark possesses purgative properties which are usually not exploited in medicine. It cures acute gout. The resin after subjection to heat in a cashew shell (*Anacardium occidentale*) is used in the treatment of ulcers. In association with other drugs, the resin functions as a anthelmintic.

Goraka is used widely in the treatment of animal disorders. A water infusion of the rind is employed as a rinse in diseases of the mouth in cattle. Cattle with hoof afflictions are stood in a water suspension of the ground rind.

G. Morella and *G. indica* yield a semi-solid yellow fat, 'Kokam' butter, which is valued both as food and as medicine. The constituents in the fats from the two species are the same but the proportions differ. *G. Morella* has twice as much olein and half as much stearin in its fat as *G. indica.* The fat of *G. Morella* makes an indifferent lamp oil but may be satisfactory in the manufature of candles.

G. Cambogia is not used in medicine to the same extent as *G. Morella.* The yellow resin derived from it is not water soluble, and is accordingly of little value as paint. Hindus, however, use it for sectarial marks.

The high content of the fruit rind (pericarp) of *G. Cambogia* in acids makes it commercially valuable as flavouring and in the curing of fish. The

results of the rind analyses by Dr. D. E. V. Koch, Assistant Chemist, are as follows :—

Nature of sample.	Per cent juice Extracted.	Colour of extract.	Per cent total acids in extract.	Per cent non-volat. acids in extract.
1. Rind from fruit picked off tree in the Royal Botanic Gardens, Peradeniya .	68	pale pink	5·72	—
2. Rind from ripe fruit fallen off tree in Dodanwela	52	orange red	6·88	5·84
3. Cured commercial rind	—	light brown	29·74 in 100 gm of rind.	27·8 in 100 gm. of rind.

The analyses given above indicate that nearly 90 per cent. of the acids in the rind are not volatile, and consist almost completely of tartaric acid.

Rind used for curing is derived from fruits picked under-ripe; immature fruits are richer in acid. After removal of the kernel, the rind is sectioned into thicknesses varying inversely with the wetness of the weather; thick sections are difficult to dry. The slices usually average $\frac{1}{8}$ inch in thickness. The slices are sun-dried in thin layers for a period of 3–7 days. The material loses over 80 per cent. of its moisture on sun drying. The dried rind is smoked in a loft till such time as it is used or sold.

Deraniyagala (1933) gives a detailed account of the methods of fish curing that obtain in Ceylon; the information summarized below is derived from his paper. The use of the dried rind of *G. Cambogia* in the brine curing of fish goes back centuries. The ancient Sinhalese considered beef food for untouchables, and consumed large quantities of brine-cured (jadi) and dry-salt-cured fish (karavadu). Relays of pingos transported daily supplies of preserved fish to the palace at *Sitawaka*. The ingredients salt and goraka are used in brine-curing in the following proportions :—$1\frac{1}{2}$ cwt. salt and 14 lbs. *goraka* to an oil drum of fish; 2 cwt. salt and 20 lbs. *goraka* to a beer barrel of fish. The dried pulp of ripe tamarind is a satisfactory substitute for *goraka*, but is not widely used on account of its higher cost. The active principle is probably the same in both instances, viz., tartaric acid.

The treatment of fish in brine curing varies with size: (*a*) Fish less than 10 inches long is cured without evisceration and without *goraka*, (*b*) Fish between 10 inches and 22 inches in length is descaled (in order to secure effective penetration of the curing agents) and eviscerated. The fish then receives on one side, a succession of oblique cuts, spaced about an inch apart. The vertebral column is severed without damage to the skin on the ventral side. The head is ripped from the opercle to the snout. Salt and *goraka* are inserted into the incisions. Fish treated in this fashion are piled into wooden casks with further quantities of salt and *goraka*; layers of fish alternate with the layers of salt and *goraka*. Within a few hours of packing, the exosmosis of water into the salt converts it into a concentrate. Meanwhile, the fish in the cask is compacted by pressure, and further layers of fish are packed in till the cask is brimful. The brine concentrate is then returned to the cask, the fish is top dressed with a final layer of salt and

a. Male Flowers
b. Female Flower L.S.
c. Fruit
d. Fruit L.S.

Block by Survey Dept., Ceylon

PLATE I.—Garcinia Cambogia Desrouss.

a. Male flowers
b. Female flowers
c. Fruits

Block by Survey Dept., Ceylon

PLATE II.—Garcinia Morella Desrouss.

goraka, the lid is rammed down, and the cask is set aside to season. (*c*) Fish longer than 22 inches is cut into chunks, scarified and rubbed with pounded salt and placed in wooden barrels. Salt and *goraka* are added to the barrels which are then sealed. The fish matures in the brine that forms in the barrels.

Goraka not only possesses a pronounced acid reaction, and consequent marked antiseptic properties, but also counteracts the tang of the salt. Fish treated with *Goraka* accordingly does not demand prolonged washing prior to use.

A pickling vinegar prepared in the way described below had, at one time, been exported from Ceylon in considerable quantity : *Goraka*, the bark of *Moringa oleifera Lamk* (*Murunga S*), chillies and nutmeg are infused with fermented coconut or palmyrah toddy in stone jars exposed to the sun for three weeks and buried under ground for a further period of one month.

The dried rind of *G. Cambogia* is also used widely in flavouring curries, for polishing gold and silver, and as a substitute for acetic and formic acid in the coagulation of rubber latex.

The timber of both species, *G. Cambogia and G. Morella* is subject to early decomposition, and is accordingly used only for temporary structures. The heart wood of very old trees of *G. Cambogia* is, however, remarkably hard and durable.

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COLOUR INSTABILITY IN SOME PLANTAIN VARIETIES

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VARIATION of characters is largely manurial with such plants as the plantain, which is propagated vegetatively by planting of suckers detached from the parent plant.

In the course of observations made over a considerable period of as many as forty varieties of plantains in Ceylon, two varieties however, have displayed certain variations and as they are of rather special interest, notes are given below.

It is not attempted to explain these variations, but judging from their nature it would appear that these conditions are likely to be due to environmental or pathological causes. The possibility of these variations being bud mutations is, however, not completely ruled out.

VARIETIES UNDER DISCUSSION

(1) Red Plantain (*Musa rubra*). The "Cuba" of the West Indies. (S) *Rathu Kochchi, Rathambala, Ranel ;* (T) *Sev valai.* A variety introduced towards the latter part of the 19th century and highly esteemed as a table plantain, but sometimes used as a vegetable in the mature state. The large plump, thickly set fruits are ox-blood red and when ripe assume a very pleasing golden red colour. Easily the tallest, the most robust and magnificent looking of the locally grown plantains, this variety luxuriates in the moist and rather cool regions of the Kandy and Kegalla Districts, often producing bunches weighing over a hundred weight.

It is rather sparing in the production of suckers and normally grows to about 15 ft. to 18 ft. at the base of the crown, the stout stem often measuring 1½ft. across at ground level.

Variation.—The stem of a typical red plantain is of a reddish garnet brown colour with petioles of a lighter hue ; but it has been noticed that this colour is not stable. When a sucker of a typical red plantain is planted out, it has been observed that the daughter suckers leading from the original plant tend to vary, losing the reddish pigment altogether. The transition may be gradual and may extend throughout several generations of clonal reproduction or the dimunition or total disappearance of pigmentation may be quite sudden, so much so, that in the same stool suckers of graded colour ranging from reddish garnet brown to dark green may appear or the stool may carry on the one side suckers typical of the variety and entirely green suckers on the other side.

This colour variation is not confined to the vegetative parts only, but the degree of pigmentation also varies in the fruit bunches borne. The writer has noticed bunches with half the bunch running longitudinally down with ox-blood red fruits and the other half with green fruits. Sometimes ox-blood red and green fruits occur scattered in the bunch giving it a mosaic pattern. Individual fruits at times display sectional colour variation with red and green stripes or the reddish pigment merging into green.

Red plantain varieties that have fully deviated from the type and assumed a green colour are locally known as *Gal-Anamalu* or *Sudu-Kochchi*. Such a variant has never been observed to go back to the original red coloured variety.

Deviation from the type is not only confined in regard to skin colour alone, but the colour of the flesh and taste of fruits also vary according to the degree of deviation.

The flesh of a typical red plantain when mature is of a salmon colour turning flesh colour on ripening and is very sweet and mealy, while that of a *Gal-Anamalu* (deviated type) is of a pale yellow orange turning salmon buff on ripening and is less sweet and not so soft. As a rule *Gal-Anamalu* trees grow more massive than *Rathambala* and produce larger bunches with bigger fruits. The fruits of the red variety however, have a greater demand and fetch a higher price in the market than those of the green variety.

(2) Ash-Plantain, *Musa* (*Paradisiaca*) *normalis*, (S) *Alu-Kehel*, (T) *Sambal-Valai*. An indigenous variety normally used as a vegetable, but also eaten when ripe and reputed to be of great therapeutic value. The fruits are 5–6 inches long, rather plump, angular and covered with a greyish bloom.

This variety attains a medium height, suckers very freely and grows equally well in the moist and dry zones. The stems are slender, pale yellowish green in colour with a marked greyish bloom in the upper regions of the stem and the petioles.

Variation.—This variety is also unstable displaying deviation in colour, producing suckers which are more green and losing the greyish bloom altogether, but does not so readily deteriorate in type as witnessed in the Red plantain. In the course of variation, trees in a stool may throw out bunches with greyish fruits showing streaks of green, while bunches that appear later carry fruits that are entirely green and devoid of the characteristic bloom. Sometimes the transition is not gradual, but a sudden departure from the type takes place, when a bunch thrown out from a succeeding sucker in the same stool carries green fruits altogether.

Such a variant is locally known as *Etamuru* or *Kalu-Kehel*. The fruits do not enjoy the same popularity as that of the original *ash-plantain*, the flesh being firm with the occasional appearance of hard seeds.

In this instance too, reversion to the original ash-plantain is not known.

The ash-plantain is very susceptible to the disease known as Anthracnose of plantains, but it has been noticed that the degressed type, *Etamuru* is remarkably resistant to, if not entirely free from this disease.

THE LIMING OF SOILS

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ALL plants need calcium to build up their tissues. In particular leguminous plants require a plentiful supply of it. Lime stimulates the growth of some crops to such an extent as to assist materially in the elimination of weeds. Good farmers realize that the use of lime helps them in replacing a one-crop economy by a type of farming embracing livestock—raising and feeding, or dairying. Liming alone may make the land productive or it may be an important one of several measures necessary. The most profitable and often the most striking effects may be seen on soils good in most respects but relatively low in lime. Not the least valuable result of liming the land is the encouragement it gives to the farmer in his work and management of crop rotations and care of the soil. It has to be emphasized that the limed farm is likely to build up rather than to wear out, and the quality of its products tends to perpetuate the interests of the farm-family in the land.

FARM PRACTICE OF LIMING

Grades.—Lime for agricultural purposes should preferably be of the high calcium limestone type containing not less than 90 per cent. of carbonate of lime. Fine-ground limestone should be fine enough for all material to pass a 20 mesh sieve and at least 75 per cent. of it to pass a 100 mesh sieve. Coarse ground limestone should all pass a 10 mesh sieve and at least 50 per cent. of it a 100 mesh sieve. It has to be emphasized that in the case of very coarse material, its action in the soil will obviously be slow.

Method of Application.—Since ground limestone and other lime products in carbonate form are not harmful to plants, they may be *spread* at any time, although applying lime, cattle manure and certain ammonia containing compounds at the same time is not advised. Applying lime after ploughing, to be followed by harrowing, is the most satisfactory practice. The time and method used should, however, be decided according to conditions and convenience. The lime should be thoroughly and uniformly distributed through the soil. Burned lime and hydrated lime require more care in application as they may possibly injure tender plants or seeds with which they come into contact.

Quantity.—The quantity of lime to be applied depends principally upon the various needs of the soil and the crop and also on the climatic conditions and the time of application. Applications recommended are usually from one-half ton upwards of burned lime of from one ton upward of ground limestone per acre.

EFFECT ON THE SOIL

All soils that need lime do not require it for the same reason. As a result of liming, a soil may be benefited (*a*) through the neutralization of its acidity, (*b*) the supplying of available calcium, when this element is deficient in the soil or (*c*) the improvement of its physical condition. In some cases all these effects will be obtained at the same time. Liming has been found to favour the flocculation of heavy soils, so that better aeration and drainage result. Hydrated lime and burned lime are more effective than ground limestone in bringing this about.

Turning under the vegetation of leguminous crops for green manure is one of the principal means of soil conservation and improvement of the fertility of land. Most of the soil-conserving and soil-improving crops grow best and produce most vegetation when the soil is kept nearly neutral in reaction by liming. Soil building crops, including many of the legumes, cannot be grown successfully on some soils without first applying lime. Lime, disked in, usually increases the biological processes of ammonification, nitrification and fixation of nitrogen in all soils that are on the acid side of neutrality.

In nearly all instances the decomposition of the organic matter in a soil will be greatly hastened by liming, although in the case of peats, owing to the resistant nature of the organic matter, the process is usually slow.

Liming increases the availability of phosphoric acid in most laterite and lateritic soils. It is particularly required in the tropics where the losses of calcium are great.

Maximum returns from cattle manure, green manure crops and certain commercial fertilizers may not be obtained where adverse soil conditions such as high soil acidity, poor tilth or poor drainage exist. Applications of lime to many acid soils long under cultivation, should precede the use of manures and fertilizers.

EFFECT ON YIELD OF CROP

Leguminous crops take large quantities of calcium from the soil and therefore require a plentiful supply of it. Furthermore, many legumes are sensitive to acid soil-conditions and grow poorly or not at all where such conditions exist. In the case of a field where the acidity is only just beyond the range of tolerance of certain arable crops and pastures there is considerable inequality in growth which results in a patchy appearance owing to the distribution of acidity being often local.

This is particularly true of alfalfa, red clover and sweet clover. White clover, cowpeas and soy beans do fairly well on slightly acid soils but it has to be mentioned that they usually respond to liming.

The great majority of garden and truck crops and cereals are often benefited by liming. Lime, disked in, generally increases the carrying capacity of pastures. All members of the citrus family thrive only in soils which are well supplied with lime. In general, it could be said that applying lime will result in larger returns and lower production costs for many crops.

WHAT SHOULD NOT BE EXPECTED OF LIMING

(1) Liming can improve only the condition in the *upper* soil making for better circulation of air and water. Impervious layers of hard-pan *below* are not materially affected by applications of lime; they should be broken up by other means.

(2) Liming cannot take the place of proper crop-rotation, cultivation or soil management. In fact, rotation and all cultural methods should be studied more carefully when lime is used.

(3) Liming should not be expected to build up a soil which is deficient in organic matter unless such organic matter is supplied either in manure or by green crops ploughed in. On sandy loams, the deficiency should initially be made good by organic manuring, while in all other cases it is often necessary to lime first and thereafter to build up the organic matter content by means of green-manuring or by applications of cattle manure or compost.

(4) Liming does not greatly hasten the decomposition of the organic matter of peaty soils. Repeated liming over several years will be found necessary.

(5) Lime does not supply potash but on the contrary may depress its content and temporarily at any rate its availability in the soil. In the case of soils, low in potash, liming should be followed by the use of suitable potassic fertilizers.

THE SOIL SURVEY OF KUNNATHUNAD TALUK

A. P. A. BRITO-MUTUNAYAGAM and M. C. ABRAHAM

FOUR distinct soil types have been identified in the area surveyed and of these the laterite soil, which is generally loamy in character, of low fertility status and poor water-holding capacity predominates.

The other types are alluvial soils, sandy loams and the kari soils, which are heavy clay soils, rich in highly acidic organic constituents.

The soils of the area surveyed have been regarded as being satisfactory in nitrogen, but their contents of total and available phosphoric acid and of available potash have been found to be low to extremely deficient.

The most noticeable feature of these soils is the fact that they are extremely deficient in lime, the total content of which is often lower than the percentage of total potash.

Remedial measures to correct for soil deficiencies have been suggested by the authors.—*D. E. V. K.*

REPORT OF THE PROCEEDINGS OF THE TENTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD AT PERADENIYA IN THE ASSEMBLY HALL OF THE SCHOOL OF AGRICULTURE, AT 10.30 A.M. ON MONDAY, AUGUST 12, 1946.

Mr. L. J. Seneviratne, Director of Agriculture, presided and the following members were present :—Mudaliyar N. M. Abulcassim Marikar ; Dissawa A. E. Madawala ; Mr. S. Sivapalan ; Mr. R. T. Chelliah ; Sir J. P. Obeyasekera ; Mr. S. Muttutamby ; Mr. S. G. Taylor, Director of Irrigation ; Mr. E. H. R. Tenison, Acting C. D. A. M. ; Mr. R. H. Spencer-Schrader ; Mr. A. G. Divitotawela ; Rev. Fr. L. W. Wickremasinghe ; Gate Mudaliyar N. Wickramaratne ; Mr. U. B. Unamboowe ; Dr. A. W. R. Joachim, Acting Deputy Director of Agriculture ; Mr. R. Bois,; Dr. D. E. V. Koch, Acting Chemist ; Mr. C. N. E. J. de Mel, Principal, School of Agriculture ; Mr. T. M. Z. Mahamooth, Acting Deputy Director (Animal Husbandry) and Government Veterinary Surgeon ; Mr. J. J. Heider ; Mr. C. A. M. de Silva ; Mr. James P. Fernando ; Colonel T. Y. Wright ; Sir Wilfred de Soysa ; Dr. R. V. Norris, Director of Tea Research Institute ; Dr. R. Child, Director, Coconut Research Scheme ; Mr. C. B. Edwards ; Mr. Marcus S. Rockwood ; Dr. W. R. C. Paul, Divisional Agricultural Officer, South-Western Division ; Mr. C. A. de Silva, for Director, Rubber Research Scheme ; T. B. Poholiyadde Dissawe ; and M. J. Perera, C.C.S., Secretary.

The following visitors were also present :—Mr. G. de Soysa, C.C.S., Commissioner for Co-operative Development ; Mr. Chas R. Turbert, Specialist in Animal Husbandry ; Mr. E. J. Livera, Divisional Agricultural Officer, Southern Division ; Mr. S. K. Thuraisingham, Supervisor of State Farms ; Mr. J. E. Senaratne, Assistant in Systematic Botany ; Mr. W. Mathewson, Agricultural Engineer.

Letters and telegrams regretting inability to attend the meeting were received from the following members :—Mr. Bruce S. Gibbon ; Mr. A. R. Panditteseker a ; Mr. N. E. Ernst, Land Commissioner ; Mr. Bertram de Zylva ; Mr. H. W. Amarasuriya ; Gate Mudaliyar M. S. Kariappar ; Mudaliyar K. Chinnatamby ; Mr. K. Kanakasabai ; Mr. A. T. Sydney-Smith ; Mr. S. L. Bandara Dharmakirti ; Mr. C. N. D. Jonklaas ; Mr. Wilmot A. Perera ; Mr. H. E. C. Lushington, Conservator of Forests ; Mr. W. Dulling.

1. CONFIRMATION OF THE MINUTES OF THE LAST MEETING.

The minutes of the last meeting held on February 18, 1946, which had been circulated among members were confirmed subject to the amendments which had also been circulated to members.

The Chairman next referred to the regrettable death of the late Sir Solomon Dias Bandaranaike and mentioned that the late Sir Solomon Dias Bandaranaike's association with the Board of Agriculture dated back to the old Ceylon Agricultural Society of which he was a member and he also served in a similar capacity on the Board of Agriculture of the Ceylon Agricultural Society which was founded in 1904.

When the first Board was constituted by Ordinance No. 37 in 1922, Sir Solomon was nominated by H. E. the Governor to serve on the Board. He served in the Estate Products Committee, and in the Board of Agriculture, as well as on its Executive Committee. He was not a member of the present Central Board of Agriculture which was inaugurated on May 10, 1934, after which date the former Board of Agriculture ceased to function. His close association with agricultural practice lent point to his contributions to the discussions.

As a mark of respect to Sir Solomon the assembly passed the vote of condolence standing.

2. TALK ON "AGRICULTURAL MACHINERY", WITH SPECIAL REFERENCE TO CEYLON BY MR. W. MATTHEWSON (AGRICULTURAL ENGINEER TO THE DEPARTMENT OF AGRICULTURE).

The Chairman introduced Mr. W. Matthewson to the Board and siad that Mr. Matthewson had been chosen for the Department by the Colonial Office to help them to find out what best to do with the Agricultural implements imported to Ceylon, to find out Ceylon's requirements and how best to tackle the peculiar soils found in this Island. Mr. Matthewson had been in the Department for nearly a year and had toured the country extensively.

"Tractors were first introduced into U. K. about 1923 after the first world war. These machines were heavy and clumsy and not adapted for the land. (The "Overtime" and "Titan" were two of the types in use at that time). American designers improved on these machines in the succeeding years, and a number of fairly reliable tractors came on the market, among these being two of British manufacture, the Austin and the Rushton, and of course the well known Fordson which is produced at Dagenham.

Unfortunately due to the depression after the war Austin and Rushton ceased to manufacture tractors, and have not again ventured to do so, leaving the field clear to the American manufacturers. The Ford Co. still of course manufacture the Fordson in large numbers and it may be said that during the present war these tractors have been the keystone of the Ministry of Agriculture's effort in food production. Also made in U. K. are the Marshall and the David Brown, besides a number of small tractors including two very useful machines which are both on tracks, the Ransomes and the Bristol.

Against this America produces an imposing line of tractors of many makes and types too numerous to mention, and at present she leads the field in both production and design.

TRACTOR-TYPES

We have two different types of tractors in general use to-day. The wheel tractor and the tracklaying tractor each of which is manufactured in various models.

The general purpose wheel tractor is the most common type of tractor in use today probably due to its adaptability. This machine can be used either with steel or pneumatic wheels, the steel wheels being fitted when doing cultivation work and the pneumatics for haulage purposes. The pneumatics are also useful on the land, and many farmers never change over to the steel wheels but take other measures to reduce wheel-slip. (1) The tubes are filled with water, the extra weight giving greater traction, or strakes are fitted to the wheels. These strakes can be adjusted to project beyond the tyres thus acting on the same way as a steel wheel fitted with spade lugs.

The tractlaying tractor is not so common because it is relatively expensive both to buy and maintain, although from an engineering point of view it is more efficient. Again this is a one-purpose machine and is (or should) only be used for cultivation.

The higher maintenance costs are due to track wear, and here I would quote a statement made by a prominent Agricultural Institute.

> "While tractlaying tractors are highly efficient as regards rolling resistance and wheel slip, they should always be worked on the lowest possible gear. This is because of *track wear* which increased more or less in proportion to the speed of travel. Track wear is the most expensive item among maintenance costs and on sandy or 'cutting' soils, it may be so great that it is not economic to use a crawler tractor at all. Large implements are necessary to use the full power of a crawler in a low gear."

The change over from animal to mechanised cultivation was in most cases done very gradually in U. K. up to 1939. When the second World War broke out this process was accelerated very considerably and tractor population increased by leaps and bounds. In Scotland

alone at the end of the war we had 20,000 tractors working. In order that these machines would be properly maintained, and the ancillary equipment set to get the best results, the Department of Agriculture appointed 12 Machinery Instructors. These Instructors were each given a district and their duties comprised of giving talks on Tractors and Machinery maintenance, how to set and work the various implements, and visit the various farms and give practical advice.

The change over in Ceylon from animal to machine has been revolutionary. As a result of this breakages have been very frequent and cost of keeping the machinery in working order has been high. This, together with the mediocre standard of work done has been due to the inexperience of the officers and tractor operators.

It is comparatively easy to drive a tractor but no driver can look after his tractor properly unless he knows something of the way it works. The modern tractor is a sturdy machine designed to stand continuous hard work but it contains a certain amount of complicated mechanism.

Again let us say a tractor works 200 days per year, making a total of 1,500 hours' work. This would be equivalent to a car which covers a 45,000 mile annually (which mileage is very uncommon for most cars) whereas the car is running on roads the tractors spend all its life in the field working under the worst conditions having to contend with dust which gets into the moving parts. and also in muddy conditions which puts extra strain on the engine, and transmission.

It will be seen therefore that a tractor should get much more attention than a car but unfortunately this is not the case. The point I would like to stress here is that while it is easy to drive a tractor, the operator should realise that he is in charge of a valuable and in some ways delicate piece of mechanism, and should treat it accordingly.

If through neglect or ignorance a tractor does not get proper maintenance :—

(1) It will never be capable of undertaking its full duty.
(2) Repair bills will be heavy.
(3) It will break down, generally at busy times.
(4) Its working life will be considerably shortened.
(5) Fuel will be wasted.

For this and other reasons which I consider more important : setting of implements and systematic cultivation I consider that we should have a better type of operator than we have at present. I am not alone in this respect having had complaints from other officers. One of these officers asked what I thought of our present tractor operators. My reply was that they knew something about how to drive a tractor, little or nothing about the implement they were pulling behind, and less about what they were trying to do in the field.

To explain this I will describe the most important implements, their uses, and also the type I consider most suitable for conditions in Ceylon.

First of all the plough which besides being the first implement used in cultivation, is in my opinion the most important implement of all as future operations depend almost entirely on whether good or bad ploughing has been done.

The object of ploughing are as follows :—

(1) To obtain a deep seed bed of good texture
(2) To create a mellow soil for the seed
(3) To add humus to the soil by covering trash
(4) To destroy and prevent weeds
(5) To leave the soil in such condition that the air will circulate freely
(6) To leave the soil in such condition that it will retain moisture from the air
(7) To destroy insects as well as their eggs.

I would make special mention of subject Nos. (4) and (6) as these take all other objects into account.

Ploughing should be deep where the type of soil allows this, and where it is not possible to have deep ploughing the land should be broken up with a subsoiler. Deep ploughing properly done (*i.e.*, where the furrow is completely inverted) is the most satisfactory method of weed control. Again deep ploughing and to a greater extent subsoiling would go a long way to preventing soil erosion as the rains would percolate into the soil instead of rushing along the hard pan formed by continuous shallow ploughing, so carrying the top soil away.

There are two main types of ploughs, the moulboard and disc plough. The mouldboard plough is definitely the best implement to accomplish the functions mentioned by me, as this plough when properly adjusted can completely invert the furrow slice covering all top growth, and burying weeds.

The disc plough does not make such a satisfactory job of this, but it holds an advantage in new land where there are stumps. This plough can jump over these whereas the moulboard plough is liable to become entangled resulting in it being broken or twisted. The disc plough also has an advantage in very hard conditions being better able to penetrate the ground than the moulboard type. To set and work the plough properly the operator must have a knowledge of all these points besides having a knowledge of proper system of ploughing a field.

What I recommend is : use the moulboard plough wherever and whenever it can be used, and the disc plough when it is impossible to get good results otherwise.

The plough alone produces a suitable tilth for a seed bed, and other implements are used, after the plough for this purpose. A disc harrow, preferably of the heavy type set at an angle can produce a good seed bed in most soils. There are soils of the clay type which may become cloddy in which the disc harrow does not give the desired results, and a Cambridge roller may be used with more effect. This roller which is comprised of a series of rings has a pulverising action and breaks up the clods fairly effectively. In very severe conditions even this may not be sufficient, and I feel that a cultivator of the Rotary type would be the most successful implement for producing a seed bed where these conditions exist. This would of course be used after ploughing in the ordinary way.

Seed drills and manure distributors although they are of a much more complicated construction than cultivation implements are actually much easier to set correctly.

It is a question of setting them to sow the requisite quantity of seed or manure and they can be cultivated to do this in two ways.

(1) By the stationary method whereby seed is put into the hopper, one wheel jacked up and turned a certain number of times to give an area equivalent to 1/10th of an acre. The seed which is ejected is collected and weighed, and a fairly accurate result can be obtained. The other method is by measuring $\frac{1}{4}$ acre and getting the desired setting by trial and error having a known quantity of seed in the box, and weighing the remainder after $\frac{1}{4}$ acre is sown.

In both instances when this setting has been found the position of the adjusting lever should be carefully noted for future use.

The moving machine requires very little setting, but the reaper builder of which there are six in Ceylon is a more intricate machine. These have not been used here as yet, and the only satisfactory way of explaining their use is by practical demonstration. The most important point to watch when using the machines I have just mentioned is working speed.

The most satisfactory speed recognised by all the leading agriculturists is 3–4 miles per hour, *i.e.*, the speed at which a pair of horses work.

In support of this I would mention that cultivations done by animal draught are still superior to those done by mechanical means, and again mechanised cultivation done at this speed has been proved much better than that done at higher speeds.

In so far as present conditions exist in Ceylon where areas are comparatively small, I can see no future for the large tractor.

In my opinion the small tractor with steal and pneumatic wheels with directly attached and hydraulically operated implements, or the small trail-laying tractor will be much more economical and better suited to this country.

Improvements that should be made in the present tractors (and this applies particularly to Ceylon where conditons for tractor operating are very exacting) are comfort, simplicity and manoeuvrability. Better seats, labour saving devices and protection from the weather—these are the main requirements for comforts.

So far as styling is concerned I would suggest that we get away from the present conventional tractor and Agricultural Engineering Firms construct self-propelled implements such as self-propelled plough, seed drill, &c.

The self-propelled combined harvestor is already widely used in America, U. K. and elsewhere with outstanding success. This machine which has the cutter bar directly in front can go straight into a grain field, to cut and thrash the crop in one operation, and only one man is required to operate it.

If the combine harvester can accomplish this task successfully (and it does) there is no reason why other implements should not be made to work in the same fashion. The power unit could be made interchangeable to suit all the machines, and thus save the expense of having a separate engine for each.

In conclusion, and with reference to a remark made by a prominent agriculturist, Mr. Clyde Higgs, at a recent meeting, I say without any hesitation that mechanical cultivation does reduce manpower on a farm. By this I mean that acre for acre more workers are required where the old method is practised.

In Ceylon where there are still large areas to be cultivated labour requirements would of course increase as these areas were brought under cultivation."

QUESTIONS FROM THE HOUSE

Mudaliyar Abulcassim Marikar inquired what was the most suitable type of tractor that he would recommend for flat land country and whether he considered it most economic?

Mr. Matthewson : Any tractor is suitable, flat land being the ideal for tractors.

The cost would be reasonable. It would be economic if the tractor was maintained and handled properly. Cost would range from £200 and upwards, and would be reasonable.

Sir James Obeyasekera : How deep have you got to plough to destroy weeds?

Mr. Matthewson : It is not so much a question of depth as of ploughing properly, *i. e.*, completely inverting the furrow and putting all weeds to the bottom (6 in. minimum).

In winding up the discussion the Chairman expressed his thanks to Mr. Matthewson for his interesting talk which was fully appreciated by the members and remarked that the talk was most instructive.

3. The next item on the agenda was taken up.

Sir Wilfred de Soysa, Chairman of the Sub-Committee on Communal Grazing Grounds, in introducing the Interim Report of the Board's Sub-Committee on Communal Pasture Grounds (*vide* pages 18 and 19 of printed minutes of the 7th Board Meeting—November 26, 1945) made the following comments :—

> "In presenting the report of the sub-committee to formulate a scheme to provide communal grazing lands in the rural areas of the country, as the Chairman of the sub-committee I wish to emphasise on the great importance of setting apart grazing lands of sufficient size separately for (1) Milch Cattle, (2) Cart and Agricultural Cattle, (3) Slaughtering Cattle, and (4) for Buffaloes.

In Ceylon the question of cattle breeding and the provision of grazing lands had not been finally settled, though the question had been taken up on more than one occasion in the old Legislative Council but nothing has so far been finally settled. In order to bring this very important question primarily before the Central Board of Agriculture and then before the general public of the country, I have obtained necessary literature from England. In paragraph 2 of the Interim Report, we have quoted a very important paragraph issued in the publication on the Provision of Animal Fodder. The paragraph is self-explanatory and it needs no further comment. In the third paragraph of the Interim Report you will see that certain lands have been set apart for communal purposes in the villages in areas where Crown Lands are available but in provinces such as the Western and Central Provinces, I do not think such concessions are granted to the village population. We, therefore, should like to see, where there are Crown lands, certain areas should be set apart for village cattle and buffaloes in separate blocks. The sub-committee has already made a rough draft as to the scheme of supervising and controlling the systematic working of communal pasture grounds in different parts of the country, but we welcome any suggestions today which will be very useful in drafting the final Report.

As regards paragraph 4, the members of the sub-committee are in a better position to make recommendations based on the communicated article appearing in the "Ceylon Daily News" of Friday the 9th instant headed "Pasture Cultivation and improvement in Ceylon" being observations and experiments made by Mr. J. E. Senaratne, Assistant in Systematic Botany in the Department of Agriculture. It was a paper read at the meeting of the Cattle Breeders' Association on the 27th ultimo. I recommended that it should be read and carefully studied by all interested in cattle breeding. You will find that the species of grasses and legumes recommended for pasture are put down in the last part of that article. But the experiments on the lines already started by the Department of Agriculture should be continued and experiments may also be undertaken in creating new strains—that will be more nutritious and palatable and crossing varieties of the same species. For your own knowledge and guidance I wish to quote what the writer says in the first part of his paper.

During my visit to Aberystwyth in South Wales in July, 1938, I was impressed with the difference in growth and colour of the newly created and improved strains of certain grasses in comparison with the naturally grown strains of the same species. The improved grass was found to be broader in the blade, heavier in weight and also resulting in a larger quantity of hay.

With regard to paragraph 5 of the report these are necessary points that should be adopted when a system of communal grazing land comes into operation in the country.

Paragraph 6 deals with the building of "Silos" and keeping in stock "Ensilage" or "Silage" to feed the cattle during a drought. Under the same heading I would like to suggest the making of hay by allowing pasture grasses to grow to their full height without being grazed by cattle or mowed down with harrowing machines. Paragraphs 7, 8, 9, 10 and 11 deal with the working of communal pasture grounds which could be amended and elaborated to be included in a draft Ordinance that will probably come before the New Parliament.

On paragraph 12, the sub-committee has requested the Director for a list of communal reserves which I trust is now in hand. Finally in commending this report for discussion, we shall be much obliged if members of the Board would offer constructive criticisms and make necessary suggestions to enable the sub-committee to draft a final report that will be of paramount importance to the future of systematic breeding in Ceylon.

Next in importane to cattle and buffaloes I should like to see pasture grounds set apart in areas where sheep breeding could also be done on a large scale. Once the report on communal pastures is accepted, I hope the Board will elect another sub-committee to deal with sheep breeding in the country.

In reply to Mudaliyar Abulcassim Marikar, Gate Mudaliyar N. Wickramaratne (convener of the sub-committee) said that the sub-committee had not visited any areas yet but would do so before making the final report.

Col. Wright : They should find out where Crown lands are available.

4. NEW RESOLUTIONS

Mr. Marcus Rockwood moved that Mr. Spencer-Schrader's resolution (item 5 (x) on the agenda) be taken up first for discussion, seconded by Mr. C. A. M. de Silva. The members agreeing, Mr. Spencer-Schrader formally moved his resolution which reads as follows :—

> "That this Board recommends to Government the early formation of a separate Division of the Department of Agriculture solely for the purpose of surveying and investigating the various types of indigenous grasses and herbage suitable for pasture, and carrying out whatever steps are necessary to establish improved strains."

In support of his resolution Mr. Spencer-Schrader had sent in the following arguments :—

I think it will be accepted as an indisputable fact that almost all the types of imported pasture grasses have failed to establish themselves in Ceylon. The only success I can think of is *Paspalum dilatatum*. There may be a very few others that have adapted themselves to a few localities, but taken as a whole, exotic grasses have not been a success. The hand-feeding of cattle with such grasses as Guinea, Napier and Mauritius is not economical. In the first place the cost of cultivation is heavy ; in the second, it is not possible, where hand-feeding is practised, to give a cow a sufficiency of her staple food-grass. It has been established in New Zealand and elsewhere that on grass alone a cow can yield up to two gallons of milk daily, and concentrates are not necessary. Owing to insufficiency of grass in Ceylon, a minimum is fed and the deficiency is made good in concentrates which are very expensive. Using Guinea grass as fodder, my own experience has been that yields can only be maintained by feeding in addition 2 lbs. of concentrates for maintenance and 3½ lbs. for every gallon of milk produced. On this basis 9 lbs. of concentrates are required, in addition to as much Guinea grass as can be given, to produce two gallons of milk—the quantity that can be produced on grass alone, if one had a sufficiency. The high cost of cultivation of fodder grasses and the substitution of expensive concentrates for the cheaper grass are two of the chief factors which cause the price of milk in Ceylon to be much higher than in most other countries. In times such as the present, when supplies of concentrates are severely restricted, in addition to unduly high prices, milk yields decline by, perhaps, more than 50 per cent. It is probable that an unduly high proportion of concentrates in the ration of cows results in some deterioration in their offspring. I believe I am right in stating that, except in the case of the Government establishments which are run more as models than as commercial concerns, there have been very few instances where the daughters of good dairy cows have been better than, or even as good as, their dames. In my own experience, which extends for over thirty years, I have to confess that I cannot recall many cases due purely to breeding. When I had the pleasure of discussing this point with Dr. Norman Wright, he expressed his conviction that feeding contributed no less than 60 per cent. towards the improvement of stock. I would emphasise that both a cheap supply of milk and improvement of livestock depend, in great measure, on an adequacy of grass ; that the cultivation of grasses for hand-feeding cannot produce a sufficiency ; and that imported varieties of pasture grasses have not been a success. It would therefore seem that, if our livestock are to be improved and the price of milk brought down to a level at which the poorer people can obtain a supply, we have no alternative but to turn to our local grasses and attempt to improve them.

It is a fact that the work done at Aberystwyth by Sir George Stapledon and his assistant with the local British grasses resulted in almost a revolution in the methods of British farming, chiefly through the storage of abundant fertility in the soil under pastures, and that the greatest advance was achieved only when imported varieties were scrapped in favour of the indigenous. New Zealand was another country where exotic grasses were proved to be inferior to the indigenous. I am afraid, that we, in Ceylon, know very little about our local grasses, except their botanical names. Since so much depends on the improvement of pasture, I would urge that the time has come when it is vital for the welfare of the country that a special division of the Department of Agriculture be established solely for the purpose of studying our indigenous grasses with a view to improving them.

Mr. Marcus Rockwood seconded the resolution.

Gate Mudaliyar N. Wickramaratne said he was opposed to the appointment of a special officer for the work proposed on the ground that the expenditure was unwarranted, especially considering the work being done by Mr. J. E. Senaratne, Assistant in Systematic Botany.

After a brief discussion the Chairman said he took it that the Board agreed that more intensive work should be done on pasture grasses.

The motion was carried unanimously.

5. Gate Mudaliyar N. Wickramaratne then moved the following resolution standing in his name :—

> "That this Board requests the authorities to stop all slaughter of country cattle until the publication of full census figures as regards the availability of cattle in this country."

In support of the resolution he had sent the following arguments :—

"There is a danger of losing a very large percentage of our cattle if it is allowed to continue the present method of slaughter. This country is in need of more and more cattle for the growing population, for agricultural work and cattle products as milk, ghee and curd for the food of the people. If allowed the present rate of slaughter of cattle to be continued we will find the same fate of the man who killed the goose that laid the golden egg. We must be satisfied with what we get from Australia and our local production of pigs, and goats. 5,000 cwt. of meat from Australia can be shipped to satisfy those who seek for animal flesh."

Mr. Marcus S. Rockwood seconded the resolution.

Poholiadde Dissawe and Mudaliyar Abulcassim Marikar suggested the following amend ments which was accepted by Mudaliyar N. Wickramaratne.

> "That this Board request the authorities to stop slaughter of country cattle other than those found useless for Agricultural purposes and for purposes of milk production."

Gate Mudaliyar N. Wickramaratne said that he got the idea from the activities of the C. D. C's officers who went about collecting country cattle for slaughter. That would lead to a great scarcity of milk cattle and cattle for agricultural purposes. Already the custom of treating guests with curd and honey in the Southern Provinces was dying out.

Mr. Marcus Rockwood in agreeing with Mudaliyar Wickramaratne said that if they were going to conserve cattle for milk they should persuade the vedarala that milk caused no harm to people suffering from coughs, colds, fevers, &c. It was this taboo which prevented the drinking of milk by the masses.

Mr. Rockwood added that lack of water due to the drought was going to cause the greatest slaughter and suggested that surplus cattle from the Southern Province and the Sanctuary should be driven to areas where there was water and no cattle.

Mr. Spencer-Schrader : Who would decide which cattle were fit for agricultural work and which for milk production ? Where Medical Officers of Health passed cattle for slaughter, they were concerned only with the consideration whether or not the meat was fit for consumption.

Mudaliyar Abulcassim Marikar said that the Government Agent would be the proper authority.

Madawala Dissawe said that the sale of buffaloes to Colombo was causing a scarcity of cattle for ploughing in the Wanni. He suggested that the slaughter of buffaloes should be prohibited for at least 25 to 30 years ; otherwise he said the time would come when paddy cultivation would not be possible for want of plough-cattle.

Dissawe T. B. Poholiyadde said that the buffaloes that were sold for slaughter were semi-wild, which fact circumvented the prohibition of such disposal. Buffaloes went semi-wild when owners who had more animals than they could maintain turned them loose. As no cultivator would buy them in that state because they required training for a year before they were fit for work, the animals were sold for slaughter. By the time they reached Colombo, however, they were somewhat tame and a check before they were actually taken for slaughter would prevent the destruction of useful animals.

The Chairman said that the question of buffaloes was a serious one. The Government Agent, North-Central Province, had suggested that these buffaloes should be sent to the Government farms and the Department of Agriculture had undertaken to do everything possible in this matter.

The amended resolution was put to the House and was carried.

6. Gate Mudaliyar N. Wickramaratne moved the following resolution :—

> " That this Board is of opinion that the time has come to adjust more intensive methods of paddy cultivation under a uniform system of Vel Vidanes. Cultivation officer or Agricultural Instructors with an Administrative Officer possessing Scientific knowledge of the soils and cultural and manurial methods who could also act as a Liaison Officer between the Government Agents and the Department of Agriculture as such an arrangement would give far more satisfactory results to all concerned in the matter of Production of Paddy."

In support of his resolution Gate Mudaliyar Wickramaratne had sent in the following arguments :—

" I wish to state that the recent publication of statistics of Internal Purchase Scheme of paddy giving the areas under paddy during Yala and Maha seasons impressed those who are concerned with the cultivation of paddy of the efforts now being made by the authorities in the production of paddy in the Island. These statistics also revealed that the efforts would give far more satisfactory results if a uniform system is adopted in the operation of intensive methods of cultivation. Such a system would give a field commensurate with the expense and efforts of both Government and cultivator. From observations made in various parts of the country in the matter of paddy cultivation it has been my unfortunate experience that methods employed to increase the yield is haphazard and there is much room for improvement.

Mr. Marcus Rockwood seconded the resolution.

Mudaliyar Wickramaratne said that according to the latest published figure there were 850,000 acres under paddy. A proper yield from this extent would be sufficient to meet

the demands of the country. The possibilities in this direction were demonstrated by the story of the Nikaweratiya man who obtained 104 bushels of paddy from half an acre. Paddy should be completely under the Department of Agriculture and be supervised by agricultural instructors. The industry was languishing because it was not systematically organized.

Madawala Dissawe said that the North-Central and North-Western Provinces being sparsely populated areas, it was not possible for one man to cultivate ten to fifteen acres. He himself cultivated one acre and got 78 bushels, because that was the only extent he worked. Normally the villager with big fields did two ploughings and with the weeds still in the field sowed the seed and went away. He did it as a sort of rajakariya.

Poholiyadde Dissawe said he too was aware that in the North-Central Province the problem was one of manpower. Where a man stuck to his one acre and adopted improved methods he did benefit.

He said that in the North-Central Province, with the organization set apart by the Government Agent, Mr. Aluvihare, the purpose sought by this resolution had been achieved, and it was only necessary to extend the organization to other provinces.

Mudaliyar Abulcassim Marikar said that Government had done everything financially and otherwise to help paddy cultivation. There were subsidies given liberally for transplanting, manuring, &c. He did not know what the mover wanted.

The motion was put to the House and was carried.

7. ANY OTHER BUSINESS

At 1.30 P.M. the meeting adjourned for lunch. When the meeting was resumed at 3 P.M. business was deferred as there was no quorum and consequently resolutions (iii.), (iv.), (v.), (vi.), (vii.), (viii.), and (ix.) of the agenda were not taken up.

It was agreed that the next meeting of the Executive Committee of the Board of Agriculture take place on November 9, 1946, and that the 11th meeting of the Board will take place on November 18, 1946, at 9 A.M.

The meeting terminated at 4.30 P.M. after tea, provided by the Chairman.

M. J. PERERA,
Secretary, Central Board of Agriculture.

Peradeniya, August 27, 1946.

COCONUT RESEARCH SCHEME

MINUTES OF THE EIGHTY-THIRD MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 10.30 A.M. ON MONDAY, NOVEMBER 4, 1946, AT BANDIRIPPUWA ESTATE, LUNUWILA.

BOARD OF MANAGEMENT

Present.—Mr. L. J. de S. Seneviratne, C.C.S. (Chairman), Acting Director of Agriculture, Mr. C. A. M. de Silva, Chairman, L.C. P.A., Mr. Stanley Dias, Representing the L.C. P.A., Mr. Vernon Rajapakse, Representing the L.C. P.A., Mr. E. Muttukumaru, Representing the P.A. of Ceylon, Mr. A. Pearson, Representing the P.A. of Ceylon, Mr. Graham Panditesekera, J.P., U.M., Representing the Small Holders, Mr. D. D. Karunaratne, J.P., Representing the Small Holders, Mr. Thomas Amarasuriya, M.S.C., Representing the State Council, Dr. Reginald Child, Director, Mr. S. C. Kahawita, Secretary-Accountant.

Apologies for absence were received from Mr. H. E. Peries, C.C.S., the Acting Deputy Financial Secretary, and Mr. J. Tyagaraja, M.S.C.

1. MINUTES

The minutes of the previous meeting held on September 30, 1946, which had been circulated (C. P. No. 620) were confirmed.

2. STAFF

Proposed appointment of a Field Assistant and Nursery Attendant to Geneticist.—The Board authorised the Director to advertise and make the appointment of a Field Assistant and Nursery Attendant to the Department of Genetics. A supplementary vote of Rs. 900 under personal emoluments was also approved.

3. ESTATES

(*a*) *Minutes of the Estate Sub-Committee.*—The Board approved of the proposals contained in the minutes of the meeting held on August 30, 1946, which had been circulated (C. P. No. 613) subject to the amendment to paragraph 5. Labour (*a*) to read as ' that temporary cottages should be replaced by permanent structures at the rate of two (one single and one double roomed) per year.

(*b*) Mr. Stanley Dias was elected as a member of the Estate Sub-Committee in place of Mr. E. Muttukumaru who resigned from the Sub-Committee due to pressure of other work.

(*c*) & (*d*) *V. A.'s and Progress Reports of the Estates.*—The Board made the following decisions :—

(1) The Estate Sub-Committee should meet immediately after the V. A.'s visit and consider the V. A.'s report.

(2) The Estate Sub-Committee should take up the matter of the Superintendent's Bungalow at Ratmalagara Estate at its next meeting and make its recommendations.

(3) The Estate Sub-Committee should consider the under planting of Bandirippuwa Estate as recommended by the V. A. in his latest report.

4. FINANCE

(*a*) The Statements of Receipts and Payments for the 2nd and 3rd Quarters were approved.

(*b*) *Price of Seedlings and Seednuts.*—After much discussion, the Board gave retrospective sanction to the following prices for planting material as stated in C. P. No. 624, paragraph 7 :—

Seednuts Grade I	..	20 cents per nut
Seednuts Grade II	..	15 cents per nut
Seedlings Grade I	..	60 cents per seedling
Seedling Grade II	..	40 cents per seedling

The Board also approved the payment of 10 cents per seednut to estate owners as from October 1, 1946.

5. ANY OTHER BUSINESS

(1) The Board decided that the Director should expand his talk to the the L.C.P.A. given on July 18, 1946, without making it too technical and circulate it to the Board.

(2) The Chairman read a letter he had received from the Principal of the Farm School Peradeniya, wherein the Principal asked for facilities to send some of his final year students to the Coconut Research Scheme for training before leaving the school. The Board was in sympathy with the request and the Chairman was authorised as the Director of Agriculture to take up the matter with the Director of the Coconut Research Scheme.

By Order,
S. C. KAHAWITA,
Secretary,
Coconut Research Scheme.

COCONUT RESEARCH SCHEME.

MINUTES OF THE EIGHTY-FIFTH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 2.30 P.M. ON MONDAY, MARCH 3, 1947, IN ROOM NO. 202, NEW SECRETARIAT, COLOMBO

BOARD OF MANAGEMENT

Present.—Mr. L. J. de S. Seneviratne, C.C.S. (Chairman), Acting Director of Agriculture, Mr. H. E. Peries, C.C.S., Acting Deputy Financial Secretary, Mr. C. A. M. de Silva (Chairman, L.C.P.A.), Mr. Vernon Rajapakse, Mr. E. Muttukumaru, Col. W. G. Mack, O.B.E., E.D., Mr. D. D. Karunaratne, J.P., Mr. G. Panditesekera, J.P., U.M., Mr. T. Amarasuriya, M.S.C., Dr. R. Child, Director, C.R.S., Mr. S. C. Kahawita, Secretary-Accountant.

1. MINUTES

The minutes of the previous meeting held on January 6, 1947, which had been circulated were confirmed.

2. BOARD OF MANAGEMENT

The Chairman welcomed Col. W. G. Mack, O.B.E., E.D., who had been nominated by the P.A. of Ceylon as their representative on the Board of Management during the absence of Mr. A. Pearson on furlough.

3. SUB-COMMITTEES

For Staff Matters.—The following recommendation of this Sub-Committee which stood postponed from the 84th meeting of the Board were considered :

(i.) *Provident Fund.*—As recommended by the Sub-Committee for Staff Matters, at its 1st Meeting held on August 21, 1946, the Board resolved that the rate of Members' Contributions and Scheme's Bonus each be increased from 7½ per cent. of basic salary to 10 per cent. with effect from January 1, 1947.

(ii.) *Field Assistants.*—After discussion, the Board decided to revert to the proposals outlined in the Memorandum on the Future of the Scheme (page 16). It was resolved that there should be one Senior Field Assistant in each of the Divisions of Genetics and Soils. The salary scale of these posts was fixed at Rs. 96—12 of Rs. 9 to Rs. 204 *per mensem*. . The qualification of the Diploma of the School of Agriculture, Peradeniya, would as a rule be insisted on ; and the posts could be filled either by recruitment or by promotion of suitably qualified candidates from the Field Staff. The Director was authorised to make suitable appointments, any promotions of Field Assistants now in service to be with effect from January 1, 1947.

4. STAFF

Botanist.—The Board decided that the Director be authorised to write to two candidates in India requesting them to present themselves for an interview with the Chairman and the Director on a date to be fixed by the Director. They were to be paid their travelling expenses according to current rates.

The Director was also authorised to obtain confidential reports on the suitability of these two candidates for the post of Botanist from the Head of the Institutes in which they are now working.

Field Attendant to Soil Chemist.—This appointment was approved as from January 1, 1947.

5. RESEARCH

Proposed experiment on methods of Fertilizer applications.

The Board unanimously accepted the offer of Messrs. H. L. de Mel made in their letter No. 27/46 of February 19, 1946. The Soil Chemist was authorised to conduct an experiment at Marandawila Estate, Bingiriya, on the methods of fertilizer application as decided at the 78th meeting of the Board.

6. FINANCE

(1) *Planting Material.*—Increased prices as recommended in C. P. 637, which had been circulated to the Board were approved as follows :—

Grade I Seednuts	..	25 cents each
Grade II Seednuts	..	18 cents each
Grade I Seedlings	..	75 cents each
Grade II Seedlings	..	50 cents each

Other prices varieties &c., unchanged.

The rates payable to Co-operating Estates for seednuts supplied to be increased from 10 cents to 13 cents each as from February 1, 1947.

(2) *All-Ceylon Coconut Conference.*—The payment of Rs. 250 towards the expenses of the proposed All-Ceylon Coconut Conference was approved subject to the ruling of the Attorney-General that such a contribution is not *ultra vires.*

7. ESTATES

(*a*) *The monthly Reports* on the two Estates which had been circulated (C. P. 636) were approved.

(*b*) *The Visiting Agent's Reports* (C. P. 638 and 638A) were referred to the Estates Sub-Committee.

8. ANY OTHER BUSINESS

(*a*) Mr. E. Muttukumaru moved that the Coconut Research Scheme should organise periodical Conferences on matters relating to the Coconut Industry on the lines of the conferences held by the Tea and Rubber Research Institutes.

This motion was accepted in principle by the Board.

(*b*) It was decided to hold the next meeting of the Board in Colombo on April 28, 1947, at 2.30 P.M.

The meeting terminated at 4.35 P.M. with a vote of thanks proposed by Col. W. G. Mack, O.B.E., E.D.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT THE ROOMS OF THE CEYLON TEA PROPAGANDA BOARD, PRINCE STREET, COLOMBO, ON MONDAY, FEBRUARY 17, 1947, at 2.30 P.M.

Present.—The Chairman, Planters' Association of Ceylon (Mr. R. Singleton Salmon), Acting Chairman ; Mr. H. E. Peries, C.C.S. (representing the Financial Secretary) ; The Director of Agriculture (Mr. L. J. de S. Seneviratne, C.C.S.) ; The Chairman, Ceylon Estates Proprietary Association (Mr. C. A. Meakin) ; Messrs. W. H. Attfield, S. Vytilingam, M.S.C., F. Amarasuriya, H. de T. Wilkinson Kay, E. G. Groves, F. A. Bond, H. S. Hurst and Dr. C. H. Gadd (Acting Director and Secretary.)

1. The Notice convening the Meeting was read.
2. The Minutes of the Meeting held on December 13, 1946, were confirmed.

After a short discussion of a suggestion by Mr. Wilkinson Kay that the Minutes should contain fuller reports of discussions, it was decided that no alteration be made at present, and that the subject be reconsidered after the Planters' Association Headquarters have moved to Colombo when arrangements might possibly be made for a stenographer to attend the Meetings.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

Reported that Mr. W. H. Gourlay had been appointed by the Ceylon Estates Proprietary Association to act for their representative Mr. J. C. Kelly during his absence on leave.

4. FINANCE

General Finance.—Reported that the Acting Director had prepared a report on the financial position showing the need for an increase in the tea cess, and had forwarded it to the Minister of Agriculture and Lands in response to his request of January 13. In that report the need for a 50 per cent. increase in the cess was shown, *i.e.*, an increase of 7 cents, raising it from 14 to 21 cents per 100 lb. tea exported.

The Acting Director was instructed to send a copy of the report to the Director of Agriculture.

Audit Fees.—Reported that in a letter dated January 5, Messrs. Ford, Rhodes, Thornton & Co. had asked for increased audit fees for 1946, and future audits. The Chairman stated that the fees had remained unchanged for many years although salaries had increased to more than double pre-war rates.

After some discussion Mr. Hurst proposed and Mr. Bond seconded that the new rates be approved. The motion was carried *nem. con.*

Insurance.—The Board approved the recommendation of the Estate and Experimental Sub-Committee to make the following alterations to the insured values in the Estate Policy:—

(1) *Tea Stocks.*—Increase from Rs. 20,000 to Rs. 26,000. Extra cover to be obtained should stocks or tea values increase.

(2) *Factory Building.*—The cost of the Sprinkler system less outside works to be added to the present value.

(3) *Packing Materials.*—Reduce from Rs. 20,000 to Rs. 10,000.

(4) *Firewood.*—Reduce from Rs. 2,000 to Rs. 750.

(5) *Rice and Food Stocks.*—Reduce from Rs. 12,000 to Rs. 8,000.

(6) *Dispensary Stocks.*—Eliminate as the stocks are no longer held in the factory building.

SUPPLEMENTARY ESTIMATES

(i.) *Research Capital—Water Scheme.*—The Chairman stated that in order to provide a satisfactory water service to the site of the 3 bungalows approved at the last Meeting, an alteration to the existing scheme and the provision of about 4,500 feet of 2 inch piping would be necessary.

A vote of Rs. 12,000 was sanctioned for the work.

(ii.) *Research Revenue—Replacements in Senior Staff Bungalows.*—A vote of Rs. 3,000 was sanctioned for necessary replacements and repairs of floor covers and furniture, as approved at the last Meeting.

5. SENIOR STAFF

Biochemist.—Reported that Mr. J. Lamb returned to duty in Ceylon on January 13, 1947. While on leave Mr. Lamb had spent considerable time with blenders, other trade interests and engineering firms discussing matters in connection with his work on tea manufacture.

The Board wished to place on record their appreciation of Mr. Lamb's work while on leave.

Acting Director.—The Board sanctioned the application by the Acting Director (Dr. Gadd) for 8 months' leave out of Ceylon, to count from his sailing, probably in May.

The Board appointed Dr. T. Eden to act as Director during any intervals that may occur between Dr. Gadd's departure and the Director's (Dr. Norris) return from leave.

Reported that Dr. F. R. Tubbs would take charge of the Entomological Division during Dr. Gadd's absence on leave.

6. JUNIOR STAFF

Dr. H. B. Sreerangachar.—Reported that Dr. Sreerangachar, Research Assistant to the Biochemist, had resigned to take up an appointment with Sarabai Chemicals, Ltd., India, and that his services would terminate on March 5th.

Mr. M. H. E. Koch.—Reported that Mr. Koch's services as Technical Assistant to the Physiologist terminated on February 7th.

7. BOARD MEETINGS

The date of the August Meeting was altered from the 18th to the 19th. It was also decided to hold the Meeting of December 8th at St. Coombs. The Meetings of May 19 and August 19 would be held in Colombo.

8. MINUTES OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE OF FEBRUARY 18, 1947

Visiting Agent's Reports.—The Board accepted the Committee's recommendation that no change should be made in the form of the Visiting Agent's Reports. The work of the Committee was appreciated.

Agricultural Policy.—The Director of Agriculture said that he was very interested in the remarks under agricultural policy and wished to know whether the measures represented practices prevalent in plantations in the area or were adopted after due experimentation. He also said that it would be very useful for new members if a summary were prepared showing a classification on the above lines.

In the case of item (*f*), Soil Erosion, he will be glad to be informed to what extent the measures are successful in preventing soil erosion and in maintaining soil fertility; and whether, at least, accurate observations had been kept in order to give an authoritative answer on these points.

Manufacture.—The Board approved the recommendations concerning experiments to determine whether a rubber roller can be adopted for use in tea manufacture and approved the purchase of a suitable roller should the results of the experiments warrant it. The purchase of a small hand-machine for the manufacture of small quantities of clonal leaf for testing was sanctioned.

Freezing Process.—The Board agreed that investigational work on this process should cease and that Messrs. Lyons be approached regarding exchange of research information.

Legge Process.—Approval was given for the study of this process to be included in the research programme at St. Coombs.

CONFERENCE

In reply to Mr. Vytilingam, the Acting Director stated that judging from the acceptances already received a large attendance was assured.

The Meeting then concluded with a vote of thanks to the Chair.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle, March 24, 1947.

C. H. GADD,
Acting Secretary.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED JANUARY 31, 1947

Province	Disease	Cases up to date since Jan. 1, 1946	Fresh cases during the month	Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	20	20	—	8	12	—
Colombo Municipality	Foot-and-mouth	2	2	—	2	—	—
	Piroplasmosis	2	2	2	—	—	—
	Rabies	8	8	8	—	—	—
Cattle Quarantine Station	Foot-and-mouth	9	9	—	9	—	—
	Anthrax	8	8	8	—	—	—
Northern Province	Foot-and-mouth	180	180	—	101	79	—
North-Western Province	Rabies	1	1	1	—	—	—
	Goat mange	26	26	14	—	12	—
North-Central Province	Foot-and-mouth	44	44	—	4	40	—
Sabaragamuwa Province	Nil	—	—	—	—	—	—
Southern Province	Nil	—	—	—	—	—	—
Eastern Province	Foot-and-mouth	2,565	2,565	135	620	1,810	—
Central Province	Foot-and-mouth	131	131	1	47	83	—
	Anthrax	3	3	3	—	—	—
Uva Province	Foot-and-mouth	1,270	1,270	18	589	663	—

T. M. Z. MAHAMOOTH,
Acting Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, March 1, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED FEBRUARY 28, 1947

Province	Disease	Fresh cases during the month	Cases up to date since Jan. 1, 1947	Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	58	78	8	42	28	—
Colombo Municipality	Foot-and-mouth	1	3	—	3	—	—
	Rabies	15	23	23	—	—	—
	Piroplamosis	—	2	2	—	—	—
Colombo Cattle Quarantine Station	Foot-and-mouth	—	9	—	9	—	—
	Anthrax	8	16	16	—	—	—
Northern Province	Foot-and-mouth	55	235	12	155	68	—
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	—	26	14	—	12	—
	Foot-and-mouth	22	22	17	—	5	—
North-Central Province	Foot-and-mouth	94	138	—	84	54	—
Sabaragamuwa Province		—	—	—	—	—	—
Eastern Province	Foot-and-mouth	132	2,697	135	2,425	137	—
Central Province	Foot-and-mouth	185	316	4	137	175	—
	Anthrax	—	3	3	—	—	—
Uva Province	Foot-and-mouth	426	1,696	34	1,347	315	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, April 8, 1946.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED MARCH 31, 1947

Province	Disease	Fresh cases during the month	Cases up to date since Jan. 1, 1947	Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	114	192	16	158	18	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and mouth	—	—	3	3	—	—
	Tuberculosis	1	1	1	—	—	—
	Rabies	19	42	42	—	—	—
Cattle Quarantine Station	Foot-and mouth	9	18	—	18	—	—
	Anthrax	5	21	21	—	—	—
Northern Province	Foot-and mouth	12	247	12	223	12	—
North-Western Province	Rabies	—	1	1	—	—	—
	Mange	—	26	14	—	12	—
	Foot-and mouth	2	24	22	2	—	—
North-Central Province	Foot-and-mouth	3	141	—	138	3	—
Sabaragamuwa Province	Nil	—	—	—	—	—	—
Southern Province	Foot-and-mouth	109	109	—	27	82	—
	Rabies	4	4	1	—	—	3
Eastern Province	Foot-and mouth	85	2 782	135	2 562	85	—
Central Province	Foot-and-mouth	638	954	7	552	395	—
	Anthrax	—	3	3	—	—	—
	Rabies	2	2	—	—	—	2
Uva Province	Foot-and-mouth	90	1,786	54	1,624	108	—

T. M. Z. MAHAMOOTH,
Acting Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, May 18, 1947.

3——J. N. A 72805 (7/47)

METEOROLOGICAL REPORT, JANUARY, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	87·4	—0·7	70·8	+0·3	85	97	7·0	12·45	18	+ 5·17
Anuradhapura	84·8	+1·6	72·3	+3·3	80	95	5·8	8·51	12	+ 2·71
Badulla	77·7	+1·4	65·7	+2·2	84	95	6·5	9·56	17	— 0·76
Batticaloa	82·3	+0·8	75·3	+1·9	82	88	7·5	11·88	15	— 1·00
Colombo	85·4	—1·1	72·9	+1·2	84	98	6·7	3·13	13	— 0·83
Diyatalawa	72·4	+0·5	59·5	+2·2	86	97	7·8	6·63	18	— 0·01
Galle	84·6	+0·7	73·7	+0·8	86	95	5·2	6·44	12	+ 2·56
Hakgala	67·4	+0·3	53·9	+2·7	88	91	8·2	11·92	15	— 0·51
Hambantota	84·4	—0·6	73·7	+1·2	84	93	7·4	2·50	8	— 1·50
Jaffna	83·7	+0·7	73·3	+1·3	78	90	4·9	3·52	12	— 0·89
Kandy	83·4	—0·2	68·4	+1·5	78	90	6·2	10·40	10	+ 4·06
Kurunegala	86·7	+0·2	72·0	+2·4	77	93	6·4	10·00	12	+ 4·89
Lunuwila	86·0	—1·8	72·8	+2·0	82	95	6·0	5·79	11	+ 2·20
Mannar	83·4	0	75·5	+1·4	82	86	6·1	9·95	11	+ 6·11
Nuwara Eliya	67·2	—0·7	50·3	+4·0	80	87	8·0	7·04	15	+ 0·08
Puttalam	85·3	—0·2	72·2	+2·4	82	95	6·1	6·01	10	+ 2·58
Ratnapura	87·1	—2·4	72·5	+1·5	80	93	7·2	13·01	18	+ 6·75
Talawakele	74·5	+0·3	56·8	+1·6	76	85	5·8	3·71	15	— 0·16
Trincomalee	81·7	+1·2	75·4	+0·3	82	88	6·8	17·07	12	+ 8·76

Rainfall in January was above average over the greater part of the Island. Deficits of 2–5 inches occurred in a few places, in a small coastal area south of Batticaloa on the east coast (*e.g.* Thumpenkeni, —4·82 inches), in the Maradankadawala—Minneriya—Pelwehera area to the north of the Central Province (*e.g.* Pelwehera, —4·17 inches), and in the Lugal Oya—Ledgerwatta—Bandara Eliya area in the Province of Uva (*e.g.* Bandara, Eliya, —4·07 inches). Largest excesses include Horaborawewa 17·41 inches, Kobonella 16·33 inches and Deanstone 15·32 inches, all in the Knuckles Range. Stations recording 5–10 inches above their respective averages were scattered over a wide area in the Central, North-Western and Sabaragamuwa Provinces. Similar excesses were also found in the south-western corner of the Island, and in the Trincomalee-Allai area.

The distribution of the heavier rainfall was typically north-east monsoonal, and monthly totals of 30 inches and above were confined to the eastern and north-eastern slopes of the main hill ranges, and include St. Martin's (Lower) 43·62 inches, St. Martin's (Upper) 42·41 inches, Deanstone 39·87 inches, Kobonella 39·47 inches and Korahana 37·90 inches. Lowest totals for the month, of the order of 2–3 inches, occurred along the south-east coast.

There were altogether 76 daily falls of 5 inches and above, the largest being 11·52 inches at Illuktenna, 11·50 inches at St. Martin's (Lower), 11·25 inches at Dooroomadella and 11·00 inches at Korahana, all on the 11th, on which day more than two-thirds of these falls occurred.

There was an appreciable amount of well-distributed rainfall up to the 13th, of the monsoonal type in the north and east, and of mainly local thunderstorm origin elsewhere. During the last three days of this period the rain was particularly widespread and heavy. From the 14th to 25th, there was a spell of practically rainless weather. Rain was experienced again during the last few days of the month.

Temperatures were on the whole above average. The highest recorded shade temperature was 92·8° at Ratnapura on the 25th, while the lowest air temperature was 41·9° at Nuwara Eliya on the 17th. Humidities were above average, and cloud amounts generally in excess. The prevailing wind direction was north-easterly.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

METEOROLOGICAL REPORT, FEBRUARY, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	90·6	+0·8	70·0	—1·2	75	97	5·7	6·02	4	+ 0·53
Anuradhapura	86·2	—0·7	70·2	+0·5	71	93	4·3	2·71	8	+ 0·99
Badulla	79·5	+0·5	62·5	—0·8	77	97	4·8	0·99	4	— 2·18
Batticaloa	83·3	+0·4	73·5	—0·4	78	90	6·3	1·14	7	— 3.07
Colombo	87·4	+0·2	71·9	—0·4	76	90	4·0	1·66	2	— 0·94
Diyatalawa	73·8	—0·9	56·9	0	76	91	5·8	0·53	4	— 1·84
Galle	86·4	+1·1	73.6	—0·1	79	88	4·0	3·89	4	+ 0·60
Hakgala	69·4	—0·7	49·9	—1·2	78	93	5·8	1·26	4	— 2·81
Hambantota	85·7	—0·3	72·8	—0·3	79	88	5·0	0·38	2	— 1·08
Jaffna	84·6	—1·0	71·3	—1·1	74	90	4·4	4·01	5	+ 2·55
Kandy	87·1	+0·5	66·2	—1·0	68	89	4·2	0·58	4	— 1·73
Kurunegala	89·7	—0·3	69·8	0	66	87	4·2	1·10	4	— 0·89
Lunuwila	88·4	—1·6	71·2	—0·3	74	93	3·5	4·38	4	+ 2·84
Mannar	84·7	—1·6	73·8	0	74	86	3·8	1·26	3	— 0·44
Nuwara Eliya	68·8	—0·8	43·8	—1·3	72	85	5·5	0·49	3	— 1·50
Puttalam	86·7	—1·7	70·4	0	75	90	4·2	4·11	3	+ 2·74
Ratnapura	91·3	—0·3	71·6	+0.2	68	90	5·1	1·34	6	— 3·96
Talawakele	76·2	—0·2	52·5	—2·3	68	84	4·2	0·48	3	— 1·49
Trincomalee	82·3	—0·2	75·0	—0·9	78	82	5·1	7·58	7	+ 4·93

There were only four days in February with any appreciable rain, 19th and 20th, 27th and 28th. Of these rainfall on the first two days was widespread, and considerably heavy in places, a number of stations recording falls over 3 inches. Kanana Estate, Bentota recorded a torrential downpour of eight inches on the 20th a very rare occurrence for any station in February. It is a February record for Kanana Estate which has observations extending over 36 years. Rainfall on the last two days of the month was chiefly confined to the northern half of the Island, and was most intense in the neighbourhood of Mullaittivu, Kanukkeni recording 9.75 inches on the 28th, also a February record for this station with 36 years observations.

Rainfall for the month was above normal in the north and north-east, and in parts of western, north-western and north-central provinces, and generally below normal elsewhere. The largest excesses were 12.56 inches at Kanukkeni, 9.08 inches at Mullaittivu and 8.61 inches at Kankesanturai. Larger deficits, of the order of 2 to 5 inches, occurred among and around the central hills, the highest being 9.84 inches at Hendon Estate 8.64 inches at St. Martin's (Upper) Estate and 8.61 inches at St. Martin's (Lower) Estate, all on the north-eastern slpoes of the hills. Ddficits of 2–5 inches also occurred in parts of western and southern mid-country, and in an east-coastal strip extending from Batticaloa southwards.

Monthly totals generally ranged from 0 to 2 or 2 to 5 inches, but in the north and the east and in some places in the south-western low country there were several totals which exceeded 5 inches. The highest were 14.18 inches at Kanukkeni, 10.41 inches at Mullaittivu, 10.31 inches at Palampodda and 9.69 inches at Kankesanturai. Less than half a dozen stations sent in nil returns.

There were only six daily falls of five inches or over for the month, the highest being 9.75 inches at Kunukkeni on the 28th, and 8.00 inches at Kanana on the 20th.

Temperatures were generally a little below average. The highest recorded shade temperature was 94.7° at Ratnapura on the 16th, while the lowest air temperature was 33.0° at Nuwara Eliya on the 9th. Humidities were above average by day, and chiefly below average by night. Cloud amounts were generally in excess. Winds were predominantly north-easterly, and above average strength.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

METEOROLOGICAL REPORT, MARCH, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	90·0	+0·1	72·1	—0·1	78	98	6·4	15·40	20	+ 5·27
Anuradhapura	90·6	—0·4	73·2	+1·7	70	93	4·4	3·32	8	— 0·83
Badulla	82·5	+0·3	65·8	+1·6	78	95	4·5	6·23	14	+ 1·18
Batticaloa	85·5	+0·2	75·3	+0·4	80	91	6·2	3·69	8	+ 0·22
Colombo	88·5	+0·6	74·5	+0·5	73	93	5·9	6·45	12	+ 1·79
Diyatalawa	77·1	0	60·3	+2·2	79	91	6·0	6·84	17	+ 1·95
Galle	86·6	+0·4	75·8	+0·8	83	91	5·1	6·18	13	+ 0·87
Hakgala	72·5	—0·5	54·0	+2·1	76	91	6·2	5·36	16	— 0·96
Hambantota . ..	87·4	+0·6	74·8	+0·6	82	93	7·0	5·60	10	+ 2·21
Jaffna	88·2	—0·3	75·7	—0·1	75	88	3·2	3·06	8	+ 1·48
Kandy	88·7	+0·2	69·3	+0·9	75	92	5·4	6·84	15	+ 1·00
Kurunegala	91·3	—1·3	73·2	+1·2	72	93	5·3	10·61	13	+ 4·33
Lunuwila	88·7	—1·1	73·9	+0·5	78	93	4·9	5·36	10	+ 0·05
Mannar	88·1	—1·2	75·4	+0·3	76	88	4·2	4·76	7	+ 2·92
Nuwara Eliya	70·9	+0·1	48·2	+2·0	80	87	6·8	5·10	14	+ 1·01
Puttalam	88·2	—1·5	73·3	+0·4	76	93	3·6	4·60	8	+ 1·52
Ratnapura	91·4	—0·4	73·5	+1·0	76	90	7·1	17·79	21	+ 7·41
Talawakele	77·2	—0·5	56·4	+1·1	78	88	5·2	6·20	15	+ 1·58
Trincomalee	84·9	—0·5	76·0	—0·4	80	88	4·8	1·02	4	— 1·28

Rainfall in March was above normal over a large portion of the Island, deficits, generally small, being found in limited areas chiefly near Colombo, in Anuradhapura-Trincomalee area and to south of Batticaloa. Larger excesses, of the order of 10 to 15 inches, occurred in the south-western and south-eastern foot-hills, the highest being 18.91 inches at Keragala Estate, 17.96 inches at Udugama, 15.69 inches at West Haputale Estate and 15.27 inches at Blackwood Estate. The largest deficits were 3.15 inches at Pindeniya, 2.93 inches at Hanwella and 2.75 inches at Kadukkamunai.

Heaviest rain occurred in Ratnapura district and in the northern parts of Matara district where the monthly totals were generally above 20 inches, the highest being 32.41 inches at Keragala Estate, 29.09 inches at Udugama, 28.42 inches at West Haputale Estate and 28.38 inches at Gilimalay Estate. Rainfall decreased towards the north and east, monthly totals ranging from 2 to 5 inches. Parts of Jaffna Peninsula and the neighbourhood of Trincomalee received below 2 inches.

There were 14 daily falls of five inches or over for the month, the highest being 7.55 inches at Keragala Estate on the 31st.

The weather during March was essentially of the inter-monsoon type, local thunderstorm activity being markedly in evidence. Rain was fairly well distributed, the only comparatively dry periods being 11th to 15th, and 18th to 22nd. Increased rainfall occurred during the last 4 days of the month.

Temperatures were generally a little above average. The highest recorded shade temperature was 94.5° at Kurunegala on the 20th, while the lowest air temperature was 37.4° at Nuwara Eliya on the 18th. Humidities were above average, and cloud amount were in excess. Winds were variable, and below average strength.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

The
Tropical Agriculturist
APRIL TO JUNE, 1947

EDITORIAL

THE LURE OF SCIENTIFIC RESEARCH

IT has frequently been stated, though axiomatically, that the people of this country have no flair for research. Whatever views one may personally have on the subject, it is quite easy to give a number of instances to controvert this proposition, from the achievements of Ceylonese in the medical and the scientific world. From the psychological point of view, of course, there seems to be no ground for such a generalisation. The spirit of scientific research, after all, is only the human instinct of curiosity sublimated towards unravelling the secrets of nature. Potentially, therefore, the drive towards research should exist in everyone of us and to say that Ceylonese do not have this faculty is to make the uncomplimentary insinuation that they are diverting the instinct towards different, if not less desirable, ends.

Be this as it may, the experience of the Rubber Research Scheme in the matter of obtaining recruits for training in research, leads one furiously to think. After two years of effort, the institute organised a scheme whereby young graduates who have shown a certain standard of ability were to be trained for some time at Dartonfield and then sent abroad for further training. The scheme was an entirely benevolent one. The selected men were to be paid a very adequate allowance during their period of training in Ceylon and the cost of their education abroad was to be met out of the funds of the scheme. There was to be no obligation on their part to serve the scheme in any way, while, on its part, it undertook tacitly to keep them employed until such time as they were able to secure useful avenues of employment outside.

The great merit in the proposal was that the period of insecurity both financial and technical, that confronts a young scientist the moment he leaves the university with his degree, has been provided for and robbed of all its terrors. Whereas a system of scholarships will deprive an enthusiastic worker of his financial support just at the moment when he becomes a really useful adjunct to the laboratory, the present scheme gives him a stable income for an indefinite period—provided, of course, he is good enough. He is all the time

keeping in touch with his chosen vocation, while he receives what might be described as a gentle stimulation of the spirit of research, untrammelled by the requirement that certain output of original research, usually, alas, represented by comparatively trivial papers, *must* be produced.

Apart from these material advantages, the prospect of a course of training under one of the scientific personalities in Europe, was regarded by those who initiated the proposal, as certain to fire the imaginations of our young scientists. What actually happened? The posts were duly advertised. Far from applicants jostling each other to secure the posts, their number amounted to just five. The applicants were duly examined and four were rejected as unsuitable. One was offered a scholarship, chiefly because of his protestations of a consuming interest in botanical studies. He accepted the post and then promptly gave it up with its alluring prospect of unlimited opportunities for botanical research, for pedestrain job in a Government Department.

It was Professor Bernal who described the pursuit of science, sarcastically perhaps, as " one of the most absorbing and satisfying of pastimes . . . . . a game against the unknown where one wins and no one loses . . . . . which has all the qualities which make millions of people addicts of the cross-word puzzle or detective story ". To those of us whose lot in life makes us wish that our work was a little more like play, and that our play brings us a little at least of what we work for, the question naturally arises, " Why is it that our budding scientists are not attracted by this alluring pastime? Why did they fight shy of this benevolent plan of the Rubber Research Scheme, a plan so beautifully integrated to satisfy the instinct of curiosity and to allay the instinct of fear and insecurity? ".

Perhaps, the best approach to this question is to examine what research workers themselves have regarded as elements of satisfaction in their occupation. Let us turn to the pages of " The Scientific Life " for our information, as its author, Dr. Baker is clearly one who not only has secured the deepest satisfactions from his chosen work, but has also critically examined the reactions to it in others.

The first attraction, it would seem, is associated with the very act of discovery. Whether the import of the discovery be great or small, the pleasure it brings is something worth striving for. Doubtless, the degree of the pleasure that awaits the discoverer will vary with the magnitude of his earlier disappointments and the earnestness with which the task was pursued.

Apart from the act of discovery, there is the pleasure associated with the quest itself. As Dr. Baker says, " The joy of discovery is a very real incentive to research, despite the rareness of its realisation ". The scientist is attracted by the thrill inevitable to those that travel into uncharted territory, even though he discovers nothing new.

Even more important than the two mentioned, it is said, is the joy of living the scientific life. Science must be pursued for its own sake, if it is to bring its choicest gifts to its votary. To the poet,

> " Fame is the spur that the clear sp'rit doth raise
> (That last infirmity of mortal mind)
> To scorn delights and live laborious days'

The Pegasus of Science cannot be driven forward even by this "last infirmity". The scientific life must be lived in and for itself. "The youthful aspirant to fame, who reads of the honours showered on Pasteur, likes to think of himself as a great medical research worker. He forgets that Pasteur was no aspirant to fame". The austere joys of the scientific life will admit only the serene satisfaction of the approval of colleagues in the scientific life.

Another important claim for the scientific life is a certain cathartic effect on the baser emotions, which removes hate and substitutes therefor a general tolerance and benevolence towards one's fellowmen. At the same time, it is not without its dangers, for it seems to create what are obviously neurotic trends, which are apt to make the scientist a peculiar, though harmless, individual.

Clearly, the number of persons, who will be moved to adopt the scientific life by such lofty ideals, must necessarily be extremely small. They are the true leaders in scientific research, the "initiates" in the scientific life, who pursue science as an end in itself and through whom the ideas that are worth while for the progress of science, get revealed to the world. They are rare efflorescences that cannot be purchased in the public market at so much a shilling.

Yet, science has succumbed to the temptation to hold up such as these and the ideals that impel them as examples for all workers in scientific research. By doing so, however, it has discouraged and frightened away the timid and the mediocre. Indeed, it seems correct to say that this is one of the reasons for the want of popularity of scientific research in this country. On account of these other-worldly ideals, scientific workers, like epileptic and psychotic persons in an earlier society, have come to be regarded as "possessed" of unique aptitudes and abilities, not to mention unique temperamental aberrations. The outstanding geniuses in the realm of science have contributed to create an idealized picture of the scientific worker as a mixture of brilliant talents and peculiarities in behaviour. It is no wonder that the average science graduate despairs of emulating either of these unusual characteristics.

If scientific inquiry can fittingly be the vocation only of geniuses such as these, the number of workers will be counted in tens only, and not in tens of thousands, as is now the case. Clearly, therefore, a category of scientific worker must exist whose duties, though not of the first magnitude in importance, should prove a better attraction to a moderately good man. Propaganda on these lines should secure better results in this country than have been achieved so far.

The examples of Thoreau, for instance, in his lonely hut at Walden Pond or of Spinoza refusing professorships at Neidelberg in order to maintain his intellectual integrity are hardly the ones to attract ordinary, normal mortals. Far more pleasing would be the prospect of a reasonable competence, with a place in a team of research workers, where the initial responsibility is distributed in proportions graded according to the abilities of each. Those with wings, of course, are free to soar higher from these lowly regions.

Even more important for this country is the establishment of a tradition of research. During the last hundred years, many new and desirable activities have become a feature of this country, each with its own ideals and standards of what is and is not correct—the public service, for instance;

the learned professions; the planting industry; the sphere of business; and finally, the tradition of culture centring round the persuit of other people's knowledge, if one may put it that way. But the tradition of trying to solve one's difficulties by patient investigation on the basis of scientific method has not established itself here so far. This does not mean, as emphasised earlier, that the people of this country have not, in individual instances, displayed their ability to conduct research. All that is emphasised is that a tradition has not got established. Obviously, the responsibility for creating this goal for our young intellectuals devolves on the University. This has now been in existence for over 20 years, and yet recently, the Vice-Chancellor was heard to comment on the absence of original research as a marked feature in its life. Perhaps, what is actually missing is results, and results have a way of not manifesting themselves for a long, long time, in spite of earnest effort. It is a matter for pride that the work of certain faculties in our University has recently attracted the attention of academic circles overseas. This is a very welcome sign, for all earnest intellectual endeavour attracts recruits like moths to a light, even though their hopes of worldly advancement are the sacrifice that keep that light alive.

STUDIES ON CEYLON SOILS

XVII.—THE PHYSICAL AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE MAJOR SOIL TYPES OF CEYLON

BY

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SUMMARY.

THE study of the physical and physico-chemical characteristics of the major soil types of Ceylon has revealed that :—

(i) In respect of specific gravity, pore space, water holding capacity, ignition loss, sticky point moisture and volume expansion, Ceylon soils are not dissimilar to the laterite and red soils of India and those of other tropical countries. Where marked divergences occur, they relate to local soils of high organic matter content.

(ii) High positive correlations exist between clay content and the water hoding capacity, sticky point moisture, moisture equivalent (Bouyoucos) and loss on ignition of the soils. The organic matter content is similarly correlated. Regression equations between the various factors have been worked out and discussed.

(iii) The rate of percolation and degree of friability of the soils are determined by the nature and amount of the clay in them.

(iv) The ultimate pH (U) of the soils is related to the nature of their clays, as characterized by the silica/sesquioxide molecular ratios of the latter (M). The relationship is an inverse one and is expressed by the regression equation $U = 4 \cdot 46 - 0 \cdot 43M$.

(v) The degree of dispersion of the soils and hence their erodibility appears to be governed mainly by the nature of the clay, the non-lateritic soils showing highest and laterite soils lowest dispersion ratios.

(vi) The base exchange capacity of the soils is determined by the amount and nature of both the clay and the organic matter. The contribution of these constituents to the exchange

capacity of our soils varies from 0·05 to 0·55 mgm. equivalents per gm. of clay and from 1·1 to 4·7 mgm. equivalents per gm. of organic matter.

(vii) There is, in general, a parallelism between the pH values and (*a*) the silica/sesquioxide ratios of the soils, (*b*) their degrees of saturation with respect to bases.

The soils of the dry zone of the Island are lateritic or non-lateritic in nature. They generally have high exchangeable base capacities when of high or medium clay content, low ultimate pH values, and frequently high base saturation percentages. They are thus neutral or moderately acid in reaction and fairly rich in available mineral nutrients. Their dispersion ratios are relatively high. They, therefore, tend to be easily erodible. Some of them are not friable when dry, and, when wet, are sticky and difficultly permeable to water. They would need careful cultivation if a fine soil tilth is desired.

The soils of the wet zone are invariably of the lateritic or laterite type. As compared with the dry zone soils they have generally lower exchangeable base capacities and are hence of lower mineral nutrient status. They are less saturated with bases and consequently more acid in reaction. Being more permeable to and less dispersible in water they drain better and are not so erodible as the former soils. They are also more friable when dry. They are, therefore, more amenable to cultivation under varying moisture conditions than the dry zone soils.

INTRODUCTION.

The study of the physical characteristics, particularly of the "single value constants" of soils has been the subject of investigation by a number of workers in other countries, notably Keen and Coutts (1) in Britain, Coutts (2) and Marchand (3) in South Africa, Prescott and Poole (4) in Australia, Hardy (5) in the W. Indies, Sen & Deb (6) in India, and Bennett in the U. S. A. (7). Little or no work has been hitherto done on this aspect of Ceylon soils, and it is with the objects of ascertaining (*a*) whether our soils conform generally in respect of their physical characteristics to those of other countries and (*b*) the significance of "single value constants" in the classification of local soils, that these investigations were undertaken. Simultaneously with these studies, the investigation of the relationships between the physical and physico-chemical properties and the chemical nature of our soils was carried out.

It would be useful here to review briefly the findings of previous workers on the subjects under discussion. All the earlier work had pointed to a very close relationship between the moisture status of the soil and the loss on ignition, which is a measure of the inorganic and organic colloid content of the soil. The sticky point moisture, moisture equivalent and hygroscopic water show a high degree of correlation with this factor. Most workers have found a positive correlation between these characteristics and the clay content of the soil, but when the partial correlations between the various factors are calculated, the relationships become much less definite in some cases.

The chemical nature of the soil has been found to have marked influence on the physical and physico-chemical properties of the soils. Laterite and lateritic soils of tropical countries, characterized by a silica/alumina

molecular ratio of less than 2 in their clay fraction, have markedly different properties to the non-lateritic soils of tropical and temperate regions. The former are much less plastic and more friable, have higher combined water contents, lower swelling coefficients, expansion values and cohesiveness, and are less erodible and more permeable to water than non-lateritic soils. Their clays have appreciably lower base exchange capacities and higher ultimate pH values than non-lateritic clays. Laterite and lateritic soils, being formed under conditions of high rainfall and temperature, are of lower exchangeable base content, more unsaturated and hence more acid in reaction than non-lateritic soils. These physical and physico-chemical properties have, therefore, a close bearing on the agricultural values of local soils.

EXPERIMENTAL.

Under the temperature and rainfall conditions in Ceylon generally, the soils tend to be of the lateritic or less frequently of the laterite type, but large extents of non-lateritic soils occur in the "dry" zones of the Island. This has made possible the selection of local soils of somewhat widely-differing character. Thirty three soils have been included in the study. The physical characteristics investigated, the methods of determination adopted and the letters by which they are designated in the tables are as follows :—

1. Clay content (C) by the international method of mechanical analysis.
2. Hygrosopic water (R) by heating to constant weight at 105°C.
3. Sticky point moisture (S) by Keen and Coutt's method.
4. Loss on ignition (I) by heating in a muffle furnace to constant weight.

5–9. Waterholding capacity (W), volume expansion (V), pore space (P), apparent (So), and real specific gravity (Si), by Keen & Raczkowski's box method (8).

10. Moisture equivalent (E) by Bouyoucos' method (9).
11. Dispersion ratio by a modification of Middleton's method (10), using the settling times now adopted for silt and clay.
12. Rate of percolation (Rn) by Singh's (11) modification of Bouyoucos' technique.
13. Crushing force (P) by a simple modification of Papadakis' (12) method. The procedure adopted was as follows :—5 gms. of air dry soil are brought to the sticky point and made into a ball which is allowed to dry at air temperatures and then at 100°C. The ball is placed in a slight depression at a fixed point on a slab of wood partly faced with a metal sheet, to one end of which is hinged a similar slab of known weight. To the other end of the latter is fixed a pan. Weights are added to the pan till the ball just begins to crumble. The mean of 3 to 5 determinations per soil sample is taken. The crushing force is then calculated.
14. Friability index (F) of the clay. This is obtained from the formula $C/P \times 100$, C being the clay content and P the crushing force.
15. Base exchange capacity (B) Olson and Bray's (13) method. Organic matter (O) was estimated by the Budapest or dichromate method and the silica/alumina and silica/sesquioxide ratios from fusion analysis of the clay fraction.

PHYSICAL CHARACTERISTICS.

Results and Discussion.

The results of the determination of the physical characteristics are presented in *Tables I.* and *II.* The correlation coefficients and partial correlations between some of these factors are shown in *Table III.* In *Table IV.* are set down the range of variation of the more important characteristics of local soils, of the red laterite and lateritic soils of India and the tropical soils of Natal and Transvaal. The regression lines showing the relation between certain pairs of factors are shown in diagrams *I to V.*

An examination of the data in *Tables I, II. and IV.* will indicate that in respect of the specific gravity, pore space, water holding capacity, ignition loss, sticky point moisture and volume expansion, Ceylon soils are not dissimilar to the laterite and red soils of India and of other tropical soils generally. Where marked divergences occur, they relate to local soils of high organic matter content.

It will be observed from *Table III.* that there is a significantly high correlation between clay content and ignition loss, sticky point moisture and moisture equivalent, while that between clay content and hygroscopic water, though significant, is not marked. In other words the heavier soils have generally the higher values for these characteristics. The correlations are, however, reduced, and in the case of that between clay and hygroscopic water, becomes insignificant when the contribution of the loss on ignition to this correlation is eliminated. The highest correlation observed is that between ignition loss and sticky point. Confirmation is thus afforded of the finding of previous workers that the sticky point is largely controlled by the ignition loss (organic and inorganic colloidal material) and to a lesser degree by the clay content.

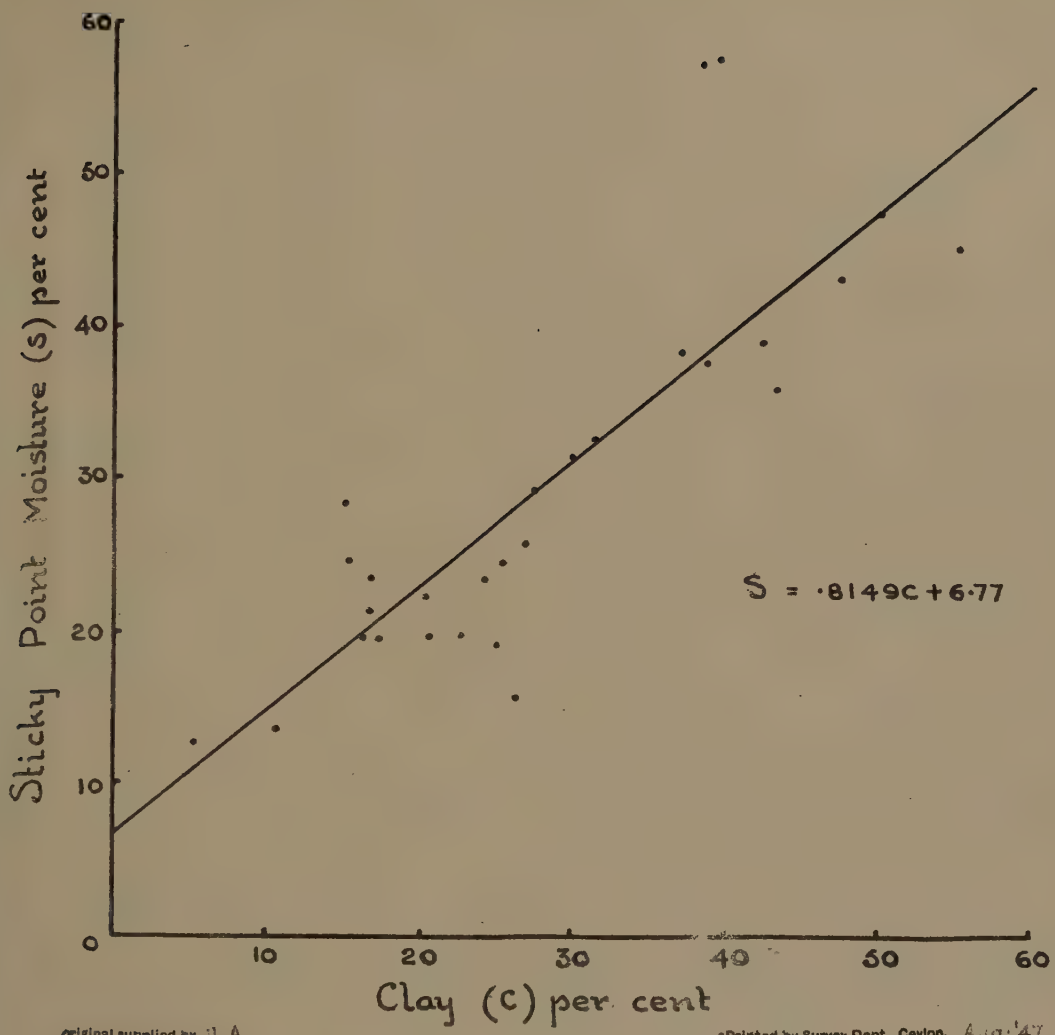
The equations showing the relative contributions of the clay (C) and organic matter (O) contents to the ignition loss (I) and the sticky point moisture(S) have been worked out by the method of partial regression coefficients and are as under :—

$$I_{oc} = 1{\cdot}93\ O + 0{\cdot}24\ C - 0{\cdot}3 \quad (R = {\cdot}9406)$$
$$(PI = 66{\cdot}1\%)$$

$$S_{oc} = 0{\cdot}88\ O + 0{\cdot}66\ C + 8{\cdot}8 \quad (R = {\cdot}7969)$$
$$(PI = 39{\cdot}6\%)$$

The multiple correlation coefficients (R) between the various factors are shown in brackets. From these the precision index (P. I) values have been calculated. It will be observed that the *amounts* of clay and organic matter of the soil samples account, on the average, for about 66 per cent. of the ignition loss and only about 40 per cent. of the sticky point moisture. Other factors such as the *nature* of the clay and the organic matter, &c., will account for the remainder.

Our data also confirm Sen and Deb's observation that the hygroscopic moisture (in their data, the moisture at 50 per cent. vapour pressure) is determined less by the clay content than by the ignition loss.



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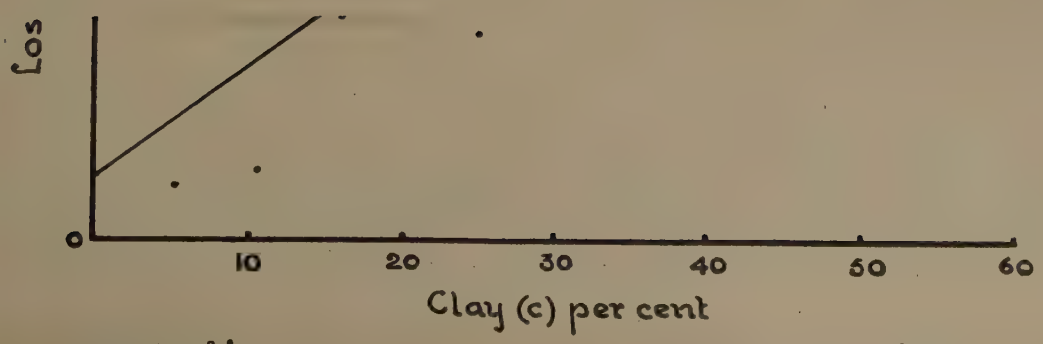

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TABLE I

Location.	Clay. Per Cent. C	Organic Matter. Per Cent. O	Appropriate Specific Gravity. So	Real Specific Gravity. S1	Maximum Water holding Capacity. Per Cent. W	Pore Space. Per Cent. p	Volume Expansion. Per Cent. V	Rate of Percolation. Min. Sec. Rn
Non-Lateritic Soils.								
1. Minneriya, Jungle A. Low country dry zone	20·7	2·39	1.32	2.66	41·1	45·1	5·9	24— 0
2. Minneriya, Damana A. Low country dry zone	25·3	1·39	1.31	2.64	37·8	45·9	9·1	20— 8
3. Minneriya, Damana C. Low country dry zone	27·5	1·02	1.30	2.04	36·6	45·5	—	35—40
4. Minneriya, Damana A. Low country dry zone	20·2	1·64	1.25	2.59	38·5	44·5	12·9	42—10
5. Minneriya, Damana C. Low country dry zone	26·9	0·98	1.34	2.66	39·4	42·7	—	7—hrs.
6. Vavuniya A. Low contry dry zone	22·6	2·82	1.33	2.36	35·8	43·9	4·4	27— 0
7. Vavuniya C. Low country dry zone	18·7	1·25	1.36	2.42	33·0	44·2	5·3	16— 5
8. Nalanda A. Low country dry zone	25·0	2·07	1.35	2.43	37·1	46·3	5·8	20— 0
9. Nalanda C. Low country dry zone	32·8	1·14	1.32	2.29	39·9	46·0	6·2	
10. Marawila A. Low country semi dry zone	5·2	0·72	1.54	2.44	23·1	35·1	—	8— 0
11. Marawila C. Low country semi dry zone	10·6	0·60	1.47	2.47	24·2	35·9	—	2— 0
Lateritic Soils.								
12. Jaffna A. Low country dry zone	26·2	0·77	1.35	2.47	36·7	44·8	4·1	21— 5
13. Jaffna C. Low country dry zone	41·7	0·57	1.31	2.43	40·4	47·6	4·3	13—10
14. Sigiriya A. Low country dry zone	24·2	3·41	1.27	2.32	42·7	48·1	6·8	16— 0
15. Sigiriya C. Low country dry zone	41·1	0·75	1.28	2.38	41·8	49·2	5·3	9— 0
16. Rikiligaskada A. Mid country wet zone	37·0	3·90	1.21	2.15	48·6	51·2	7·0	11— 0
17. Rikiligaskada C. Mid country wet zone	39·5	3·17	1.19	2.24	47·0	49·2	5·5	4— 0
18. Ambepussa A. Low country wet zone	43·2	3·13	1.18	2.06	46·2	46·8	9·6	9 —0
19. Ambepussa B. Low country wet zone	55·0	1·61	1.15	2.00	53·7	49·1	8·7	11— 0
20. Peradeniya A. Mid country wet zone	39·6	4·02	1.00	2.06	67·2	61·3	9·6	4— 0
21. Peradeniya B. Mid country wet zone	47·4	4·29	1.05	2.13	63·2	54·3	7·9	5— 0

Location.	Clay. Per Cent. C	Organic Matter. Per Cent. O	Appropriate Specific Gravity. So	Rea Specific Gravity. S1	Maximum Water holding Capacity. Per Cent. W	Pore Space. Per Cent. P	Volume Expansion. Per Cent. V	Rate of Percolation. Min. Sec. Rn
Laterite Soils.								
22. Bopath. Forest A. Up country wet zone ..	36·4	12·92	0.99	2.34	70·7	57·7	—	2— 7
23. Bopath. Forest B. Up country wet zone ..	43·4	1·83	1.07	2.46	66·0	56·5	—	2— 0
24. Bopath. Patana A. Up country wet zone ..	38·3	9·49	0.88	2.36	94·9	62·7	—	1—40
25. Bopath. Patana A. Up country wet zone ..	47·5	4·76	1.01	2.67	68·5	62·1	—	1—50
26. Balangoda A. Mid country wet zone ..	42·4	4·32	1.19	2.18	54·5	52·3	—	1— 8
27. Balangoda C. Mid country wet zone ..	38·7	1·24	1.13	2.10	46·2	49·5	—	0—54
28. Pasdun Korale Forest A. Low country wet zone..	16·7	2·45	1.15	2.62	38·6	56·1	—	2—55
29. Pasdun Korale Forest C. Low country wet zone .	17·3	1·43	1.24	2.61	35·5	52·5	—	2—41
30. Pasdun Korale—Fernland A. Low country wet zone ..	15·0	5·00	1.00	2.05	39·5	57·9	—	2—09
31. Pasdun Korale—Fernland C. Low country wet zone ..	16·[illegible]	2·33	1.23	2.54	37·8	51·5	—	2—49
32. Horana A. Low country wet zone ..	16·1	2·37	1.29	2.09	35·7	41·2	7·4	6— 0
33. Horana C. Low country wet zone	17·1	1·19	1.37	2.17	34·8	39·7	5·4	2— 0

TABLE II.

Location.	Clay Si/Al ratio.	Si/R ratio.	Clay. Per Cent.	Organic matter. Per Cent.	Loss on ignition. Per Cent.	Combined water. Per Cent.	Hygroscopic water. Per Cent.	Sticky point moisture. Per Cent.	Moisture equivalent. Per Cent.	Dispersion ratio.	Crushing force.	Friability Index.
	A	M	C	O	I	H	R	S	E	D	P	F
Non-Laterite Soils												
1. Minneriya Jungle A Low country dry zone ..	4.68	3.45	20.1	2.4	9.7	2.5	4.8	19.8	18.9	—	94.4	21.9
2. Minneriya Damana A Low country dry zone ..	3.07	2.41	20.2	1.6	8.3	3.0	3.7	22.3	20.4	17.1	124.1	16.3
3. Minneriya Damana C Low country dry zone ..	3.07	2.36	26.9	1.0	8.8	3.1	4.7	25.7	24.2	13.2	—	—
4. Minneriya Damana A Low country dry zone ..	2.86	2.26	25.3	.04	8.5	3.2	3.9	24.2	19.4	17.7	97.7	25.9
5. Minneriya Damana C Low country dry zone ..	2.80	2.23	27.5	1.0	9.3	3.5	4.8	29.3	28.1	16.7	107.5	25.6
6. Tunnukkai A. Low country dry zone	2.81	2.56	31.7	.09	11.1	4.2	6.0	32.8	—	—	83.7	37. 9
7. Nalanda A. Low country dry zone	2.34	1.69	25.0	2.1	6.6	2.6	1.9	19.0	18.2	8.9	45.0	55.6
8. Vavuniya A. Low country dry zone	2.11	1.79	22.6	2.8	7.6	2.3	2.5	19.9	14.7	12.6	35.4	63.8
9. Marawila A. Low country semi dry zone ..	2.02	1.67	5.2	0.7	1.9	0.7	0.5	12.6	8.1	10.4	5.4	96.3
10. Marawila C. Low country semi dry zone ..	1.94	1.63	10.6	0.6	2.1	1.0	0.5	13.6	9.0	10.8	—	—
Lateritic Soils.												
11. Jaffna A. Low country dry zone..	1.93	1.56	26.2	0.8	8.2	4.5	2.9	15.3	15.8	9.6	31.8	82.4
12. Mannampitiya A. Low country dry zone ..	1.84	1.45	15.1	0.9	9.8	3.1	3.8	24.6	—	—	—	—
13. Sigiriya A. Low country dry zone	1.72	1.45	24.2	3.4	9.6	3.5	2.7	23.6	21.6	9.0	31.8	76.1
14. Ambepussa B. Low country wet zone..	1.69	1.47	55.0	1.6	14.9	9.8	3.5	45.2	32.4	5.9	97.8	56.2
15. Peradeniya A. Mid country wet zone..	1.62	1.21	39.6	4.7	20.6	9.9	6.0	57.9	46.1	11.3	45.0	88.0
16. Ambepussa A. Low country wet zone..	1.59	1.40	43.2	3.1	13.9	7.8	3.0	36.0	28.3	6.3	56.8	76.1

Location.	Clay Si/Al ratio. A	Si/R ratio. M	Clay. Per Cent. C	Organic matter. Per Cent. O	Loss on ignition. Per Cent. I	Combined water. Per Cent. H	Hygroscopic water. Per Cent. R	Sticky point moisture S	Moisture equivalent. Per Cent. E	Dispersion ratio. D	Crushing force. P	Friability Index. F
17. Rigiligaskade A. Mid country wet zone	1.59	1.26	37·0	3·9	15·7	8·3	3·5	38.3	32·2	4.7	54.2	68.3
18. Balangoda A. Mid country wet zone	1.40	1.11	42·4	4·3	19·3	10·9	4·1	39.1	29·7	1.9	18.6	228.0
19. Balangoda B. Mid country wet zone	1.38	1.08	38·7	1·2	15·3	10·6	3·5	37.9	27·1	1.9	39.3	98.5
Lateric Soils												
20. Bopath. Patana B. Up country wet zone	1.30	0.92	47·5	4·8	22·2	11·5	5·9	43.1	35·8	2.8	—	—
21. Pasdunkorale Forest C. Low country wet zone	1.27	0.95	17·3	1·4	8·3	5·7	1·2	19.7	14·1	—	21.1	82.9
22. Pasdunkorale. Fernland B. Low country wet zone	1.19	0.89	16·6	2·3	9·6	4·9	2·4	21.4	15·5	—	26.1	63.6
23. Bopath. Patana A. Up country wet zone	1.15	0.81	38·3	9·5	28·5	12·8	6·2	57.5	37·2	3.1	5.4	709.3
24. Pasdunkorale Fernland A. Low country wet zone	1.02	0.81	15·0	[illegible]	14·7	5·8	3·5	28.2	20·6	3.3	5.4	277.8
25. Pasdunkorale Forest A. Low country wet zone	0.96	0.79	16·7	2	12·5	6·6	3·4	23.4	14·4	—	—	—
26. Horana A. Low country wet zone	0.84	0.71	16·1	2·4	7·1	2·8	1·9	19.7	14·3	4.0	5.4	298.1

The regression equations between the pairs of factors discussed above are as follows :—

$$C = 4{\cdot}5\,R + 11{\cdot}1$$
$$C = 0{\cdot}82\,S + 3{\cdot}4$$
$$C = 1{\cdot}53\,I + 9{\cdot}2$$
$$S = 1{\cdot}87\,I + 6{\cdot}9$$
$$S = 0{\cdot}82\,C + 6{\cdot}8$$

From the above the following conclusions may be drawn for the range of soils examined :—

(1) the colloidally held water is approximately 1·9 times the ignition loss ;

(2) the interstitial water is 6·9 per cent. This compares very closely with the value of 7·0 per cent. obtained by Keen (14) for a wide range of 250 soils of varying character from different countries, but differs markedly from the figure 16·0 per cent. obtained by him for English soils (1). This demonstrates clearly that the soil characteristics vary appreciably with the nature of the soils.

(3) the amount of mineral colloid is roughly 1·5 times the ignition loss ;

(4) about 9 per cent. of the clay in local soils does not function as such. This figure is identical with that obtained by Sen and Deb (6) for the Indian lateritic soils.

Reverting to the data of *Table III*. it will be seen that the correlations between the clay content on the one hand and pore space and water absorption capacity on the other, while being significant are not markedly so. Our results here differ somewhat from those of some earlier workers who found a very high correlation between these factors. The reason for the divergence is to be found in the widely differing nature of our soils espacially in respect of organic matter content. The simple and multiple regression equations between these factors are shown below :—

$$W = 0{\cdot}83\,C + 17{\cdot}8$$
$$W = 0{\cdot}68\,C + 4{\cdot}76\,O + 13{\cdot}8\ (R = {\cdot}8663)$$
$$C = 0{\cdot}59\,W + 3.0$$
$$p = 0{\cdot}30\,C + 40{\cdot}1$$

It will also be noted that there is a significant positive correlation between water absorption capacity and organic matter content, and that the latter contributes appreciably to the former in humic soils. The total contribution of both clay and organic matter to water absorption capacity is, however, only about 50 per cent. on the average. Pore space no doubt largely determines the remainder.

The regression between P and C for Natal soils has been found by Coutts (2) to be $p = 0{\cdot}50\,C + 37{\cdot}1$. "The pore space at zero clay", viz., 37 per cent. is not very different to that found by us, viz., 40 per cent.

The relations between the nature of the clay and ignition loss, dispersion ratio, friability and rate of water percolation will now be examined. It will be seen from *Table III*. that there is a significant, though not very high negative correlation between the silica[1] sesquioxide molecular ratio of the clay

fraction (M) and the loss on ignition. This would have been higher if the soils of the ultra-wet low country had been omitted. Sen and Deb (6) found a much higher correlation between these factors for the red lateritic group of soils. The regression equation between the two factors for our soils is $I = 17{\cdot}3 - 3{\cdot}64\ M$. It has to be emphasized that this relation is only of general applicability and would show wide discrepancies with individual soil samples. Laterite and lateritic soils generally show higher ignition losses than non-lateritic soils, especially when the effect of clay content is eliminated.

TABLE III.

Correlation Coefficients between Physical Characteristics and Clay Content.

	I	S	R	E	W	P	M
C	·7336*	·8187*	·5870*	·8487*	·6990*	·5399*	—·1097*
I	—	·9186*	·7286*	—	—	—	—.4082
R	—	·7236*	—	—	—	—	—
S	—	—	—	—	—	—	·2949

Partial Correlation Coefficients.

SI. C	·8298*	RI. S	·2344
SC. I	·5391*	SC. R	·7044*
RC. I	·1128	MS. C	—·3594
RI. C	5411*	MI. C	—·4851*

Correlation Coefficients between Organic Matter Content and Physical Characteristics.

	I	S	W	C
O	·8218*	·6711*	·7372*	·3767

*Indicates Significance.

An examination of the dispersion ratios of the soil samples shows that the degree of dispersion in water and hence the erodibility of the soils is governed mainly by the nature of the clay and not by its amount, non-lateritic soils showing highest and laterite soils lowest dispersion ratios. Calculations of the "erosion ratios" of the samples by Middleton's (10) formula have given very similar figures to the dispersion ratios in the majority of instances. This points to the conclusion that the dispersion ratio would furnish a rough index of the erodibility of local soils.

The crushing force data show that the cohesiveness of soils is determined both by the nature and the amount of clay. Laterite soils have highest friability index values and non-lateritic soils lowest values. The wet zone soils of the Island should, therefore, be more amenable to cultivation when dry than those of the dry zone.

Similar observations have been noted in respect of the permeability of our soils to water. The rate of percolation is determined both by the nature of the clay and its amount. Laterite soils are most readily permeable to water, while non-lateritic soils are least so.

TABLE IV.

Physical Characteristics.	Ceylon Soils.	Indian Red Soils. (Sen and Deb).	Transvaal Soils. (Merchand).	Natal Soils (Coutts).
Apparent Specific Gravity	0.94— 1.54	1.07— 1.78	1.27— 1.62	—
Real Specific Gravity	2.00— 2.66	2.28— 2.96	2.18— 2.51	—
Volume Expansion	4.1 —12.9	2.0 —10.0	3.7 —45.	4.2 —16.8
Pore Space	35 —63	30 —54	33 —57	33 —67
Sticky Point Moisture	12.6 —57.9	12.7 —48.3	—	19.5 —67.8
Moisture Equivalent	8.1 —46.1	—	—	—
Water holding Capacity	23 —95	22 —63	22 —63	20 —74
Ignition Loss	2.1 —28.5	2.6 —23	1 —9	2.9 —25.3

PHYSICO—CHEMICAL CHARACTERISTICS.

Sixteen typical soil samples were examined for the following physico-chemical characteristics :—base exchange capacity, total base exchange content, original and ultimate pH, and degree of base saturation. The ultimate pH was determined by the quinhydrone method on electrodialysed samples of the soils. The results are shown in *Table V*.

Attempts were also made to ascertain the relative contribution of the clay and organic matter to the base exchange capacity of selected local soil types. This was done by three methods : (*a*) by determining the base exchange capacity, clay and organic matter contents of the A and C horizons or one of two representatives soil profiles of each of the three groups of soils and calculating the unit clay and organic matter base capacities by algebraic methods ; (*b*) by ascertaining the clay, organic matter and base capacities for a number of soils in each group, averaging the results, and solving the indeterminant equation so obtained for positive, integral values ; (*c*) by Craig's (15) procedure which consisted in determining the base exchange capacity of the air-dry soil and of soil heated to 250°C with ammonium nitrate, at which temperture he found that the organic matter was destroyed. This method was found, however, to give in certain cases appreciably lower values for the base capacity of the clays than those obtained by the first two methods indicated.

RESULTS AND DISCUSSION.

The relation between the ultimate pH and the nature of the clay (Si/Al and Si/R molecular ratios) is descernible from the high negative correlation coefficients between the two pairs of factors, viz.,—0·902 and—0·884 respectively and the regression equations

$$U = 4{\cdot}63 - 0{\cdot}43\ M_1$$
$$U = 4{\cdot}61 - 0{\cdot}34\ M_2$$

where M_1 is the Si/R molecular ratio, M_2 the Si/Al ratio and U the ultimate pH. These results confirm the work of Mattson (16) and Prescott and Arthur (17) who found that laterite and lateritic soils have higher ultimate pH values than non-lateritic soils. The regression line obtained by the Australian workers on a wide range of Australian, Indian and American soils, viz., $U = 5{\cdot}06 - 0{\cdot}488\ M$ is seen to be similar to that obtained by us.

The data of *Table V*. in respect of pH values, base saturation percentages and Si/R ratio show, in general, a parallelism between pH values and (*a*) the silica/ sesquioxide ratios, the more non-lateritic the soil the higher being the pH value, (*b*) base saturation percentages—the lower values being generally associated with the laterite and lateritic soils.

As regards the relative contribution of clay and organic matter to the base exchange capacity of our soils, it will be seen from *Tables V*. and *VI*. that this is dependent on both the nature and amoun of each constituent. In the case of clay, the base capacity varies from 0·05 mgm. equiv. per gm. for laterite and lateritic clays to 0·55 mgm equiv. per gm. for non-lateritic clays. The data are in general conformity with those of Mattson in the U. S. A. (16), Prescott and Hosking (18) in Eastern Australia, and Craig in Mauritius (15), but our figures are generally low owing to the lateritic nature of our soils.

TABLE V.

Location.	Clay. (C) Per Cent.	Organic matter (O) Per Cent.	Si/Al (molecular) ratio.	Si/R (molecular) ratio.	Original pH	Ultimate pH	Total exch. bases m.e. Per Cent.	Base Capacity m.e. Per Cent.	Base capacity. per gm.	Base Saturation. Per Cent.
Non-Lateritic Soils.										
1. Tambelagam. Low country dry zone	38·6	0·8	4.38	3.41	6.80	3.20	21·4	27·3	—	78·4
2. Minneriya Jungle. Low country dry zone	20·7	2·4	4.68	3.45	6.83	3.68	12·3	14·5	C : 0.55	84·9
3. Minneriya Damana. Low country dry zone	20·2	1·6	3.68	2.41	6.84	3.64	16·7	18·3	O : 3.4	91·5
4. Unnichchai. Low country dry zone	6·8	0·4	3.32	2.85	5.13	3.33	0·3	0·8	—	35·0
5. Tunukkai. Low country dry zone	31·7	0·9	2.81	2.56	8.60	3.66	76·3	—	—	—
6. Nalanda. Low country dry zone	25·0	2·1	2.34	1.69	7.20	3.96	9·4	9·4		—
Lateritic Soils.										
7. Jaffna. Low country dry zone	26·2	0·8	1.93	1.66	7.76	4.00	8·5	6·7		—
8. Rikiligaskada. Mid country wet zone	37·0	3.9	1.59	1.26	5.5	—	4·0	10·4	C : 0.16	38·4
9. Sigiriya. Low country dry zone	24·2	3·4	1.70	1.45	6.90	3.73	4·2	12·7	O : 1.76	—
10. Peradeniya. Mid country wet zone	39·6	4·7	1.62	1.21	5.56	4.31	7·5	15·3		49·2
11. Balangoda. Mid country wet zone	42·4	4·3	1.38	1.05	6.40	4.60	0·8	9·2		8·9
12. Belunmahara. Mid country wet zone	57·6	1·8	—	—	4.60	—	3·6	8·4		40·5
Laterite Soils.										
13. Bopath Patana. Up country wet zone	38·3	9·5	1.15	0.81	4.56	4.23	2·0	20·1		7·6
14. Pasdun Korale. Fernland. Low country wet zone	15·0	5·0	1.02	0.81	5.00	4.16	1·4	13·3	C : 0.08 O : 2.2	10·0
15. Pasdun Korale. Jungle. Low country wet zone	16·7	2·5	0.96	0.79	5.20	4.13	1·0	7·2	or C : 0.05	13·7
16. Horana. Low country wet zone	16·1	2·4	0.84	0.71	6.20	4.13	0·8	7·2	O : 2.05	11·1

Table VI.

Non-Lateritic Soils.	Clay (C) Per Cent.	Organic matter (O) Per Cent.	Base Exchange Capacity m.e. Per Cent.	Base Exchange Capacity m.e. per gm.
Minneriya A	25.3	1·39	15·98	C: 0·52
Do. C	27.5	1·02	19·03	O: 4·7
Lateritic Soils.				
Sigiriya A	24·2	3·41	12·34	C: 0·19
Do. C	41·1	0·75	9·45	O: 2·1
Balangoda A	42·4	4·32	9·24	C: 0·10
Do. C	38·7	1·24	5· 3	O: 1·1
Laterite Soils.				
Bopath. Forest A	36·4	12· 9	38·20	C: 0·15
Do. C	43·4	1· 8	11· 3	O: 2·5

The base capacity of organic matter appears to vary with climatic conditions. Our figures range from 1·1 to 4·7 mgm. equiv. per gm. of organic matter as compared with an average value of 2·5 found by Craig for the tropical soils of Mauritius, 5·12 for the red basaltic soils of Eastern Australia and the range of 2·5 to 4·5 quoted by Robinson (19) as the exchange capacity of humus.

GENERAL DISCUSSION.

From this study of the physical and physico-chemical characteristics of representative samples of the major types of our soils, certain general conclusions of practical importance to Agriculture in the Island can be drawn, particularly with regard to the mineral nutrient status of wet and dry zone soils and their behaviour under cultivation during dry and wet weather.

The soils of the dry zone of the Island are lateritic or non-lateritic in nature. They generally have high exchangeable base capacities when of high or medium clay content, low ultimate pH values, and frequently high base saturation percentages. They are thus neutral or moderately acid in reaction and fairly rich in available nutrients. Their dispersion ratios are relatively high. They, therefore, tend to be easily erodible. Some of them are not friable when dry, and, when wet, are sticky and difficultly permeable to water. They would need careful cultivation if a fine soil tilth is desired.

The soils of the wet zone are invariably of the lateritic or laterite type. As compared with the dry zone soils they have generally lower exchangeable base capacities and are hence of lower mineral nutrient status. They are less saturated with bases and consequently more acid in reaction. Being more permeable to and less dispersible in water, they drain better and are not so erodible as the former soils. They are also more friable when dry. They are, therefore, more amenable to cultivation under varying moisture conditions than the dry zone soils.

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UTILISATION OF COCONUT WATER

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WE have had occasion recently to analyse a large number of samples of coconut water. The studies in connection with which these analyses were done may not be ready for early publication and the present note is intended to report briefly only those results which have a bearing on the possible utilisation of waste coconut water.

The composition of coconut water alters markedly as the nut ripens. All through this paper we are concerned only with the water from ripe nuts which have been further " matured " by one month's storage after plucking, as is the usual practice in Ceylon with nuts intended for copra or desiccated coconut manufacture. These industries give as a by-product large volumes of coconut water, about 30 gallons for every thousand nuts.

For water from " matured " coconuts the range and weighted averages of our analytical figures are as follows :—

	Range.	Weighted mean.
Total Solids, gms./100 c.c.	3.9–5.5	4.71 gms./100 c.c.
Reducing sugars (as invert sugar) gms./100 c.c.	0.23–1.30	0.80 ,,
Additional reducing sugars after inversion (as sucrose) gms./100 c.c.	0.98–3.15	1.28 ,,
Total Sugars, gms./100 c.c.	1.70–3.38	2.08 ,,
Ash, gms./100 c.c.	0.50–0.84	0.62 ,,
Organic solids not identified (*i.e.*, Total solids less total sugars and ash)	—	2.01 ,,

W. R. Dunstan (1) found for water from Ceylon nuts: total solids 4·7, reducing sugars, as glucose, 0·5, sucrose 2·6, other organic matter 1·1, ash 0·5 gms./100 c.c. A. Lahille (2) found that the water from ripe nuts as used for copra making in Indochina contained about 2 per cent. of sugars, and 0·5 – 0·6 per cent. of ash.

The literature contains occasional reports of much higher figures for total solids and sugars, the highest we have encountered being that of C. G. Mathews (3), who reported on one sample 13·06 per cent. total solids and 7·3 per cent. of sugars. It will be found that such high figures have always resulted from samples of nuts sent to Europe or America, the water in which had become concentrated by evaporation during long storage.

We regard our results as typical of waste coconut water as it arises in Ceylon from copra curing and desiccated coconut manufacture, and we must agree with the first two writers quoted that there is little likelihood that

coconut water, although available in large quantities, could be successfully used as a raw material for sugar manufacture. Not only is the sugar concentration low but it is associated with too much mineral and non-saccharine organic matter.

Recently we were offered the suggestion that although certainly not an economic source of sugar, coconut water might, after fermentation, contain enough alcohol to be economically recoverable. It is true that processes have been worked, particularly in Sweden and the U.S., to recover alcohol from the waste sulphite liquor of wood pulp mills; such liquors contain only about 2 per cent. or less of fermentable sugar (4, 5). The waste material in this case, however, is produced in quantity in one place, whereas waste coconut water arises intermittently on hundreds of estates distributed over a wide area. Furthermore, coconut water, as collected, readily becomes inoculated with casual micro-organisms and spontaneous fermentation and acetification are rapid. It would hardly be possible to collect to a central factory the unfermented water.

We have made a preliminary study of the spontaneous fermentation of coconut water (as actually obtained from copra curing on Bandirippuwa estate) with the following results :

TABE I.—PROGRESS OF SPONTANEOUS FERMENTATION OF COCONUT WATER.

Date and Time of analysis	Ash gms./100 c.c.	Total solids gms./100 c.c.	Reducing sugars (As invert sugar) gms./100 c.c.	Additional reducing sugars after inversion (as sucrose) gms./100 c.c.	Organic solids not sugar : gms./100 c.c.	Alcohol w/v Per cent.	Acidity as gms. acetic acid per 100 c.c.
5.2.47 9 A.M.	—	4.26	0.41	1.77	1.31	—	0.04
5.2.47 5 P.M.	0.77	4.42	0.34	1.86	1.45	—	0.06
6.2.47 8 A.M.	—	4.06	0.32	1.61	1.36	0.05	0.09
7.2.47 8 A.M.	—	3.41	0.78	0.07	1.79	0.24	0.30
8.2.47 8 A.M.	—	2.77	0.11	—	1.89	0.40	0.38
9.2.47 8 A.M.	—	2.75	—	—	1.98	0.21	0.42

Alcohol reached a maximum of 0·40 per cent. on the third day, and then decreased owing to acetification.

Doubtless the yield of alcohol could be increased (but not above about 1 per cent.) and the quality* improved by fermenting the previously sterilized fresh water with pure yeast cultures. We do not, however, regard this as possible under field conditions on a large scale.

The prospects for production of industrial alcohol from waste coconut water in Ceylon are not, in our opinion, very promising.

As regards potable spirit a local patent (6) covers the production of beverages from coconut water; in this patented process the water is concentrated to a sugar content of 5 per cent., or reinforced with added sugar or jaggery, before fermentation.

Development of Acidity.—Fermented coconut water develops after four or five days an acidity of about 0·5 gms. per 100 c.c. calculated as acetic

* By partly concentrating the bulked distillates obtained in the course of the above analyses, a sample of dilute alcohol was obtained, 8·54 per cent. alcohol w/v (at 30°c). This had : furfural *L* 0·05, aldehydes 9·7, higher alcohols 10·1 parts per 100 litres of spirit.

acid. We have in several trials never found "matured" coconut water greatly to exceed this figure even when the water is kept longer, but Lahille (*loc. cit.*, p. 24) records one sample which after eleven days contained 0·89 gms. per 100 c.c. as acetic acid.

Such acid coconut water has been used for rubber coagulation in times of shortage of acetic or formic acids due to war emergencies (7). According to the Rubber Research Institute of Malaya the acid water from one coconut will coagulate $\frac{3}{4}$ lb. of rubber (8). Transport of such a dilute solution is not economic, but during war periods fermented coconut water has been used in Ceylon for coagulating rubber in those areas where coconuts and rubber are grown on adjoining lands. (9, 10).

Mannitol.—A sample of coconut water was sent from Ceylon to the Imperial Institute in 1904, preserved (as it was supposed) in a sealed tin with the addition of chloroform. Dunstan (*loc. cit.*) found this sample to contain 4·0 per cent. of total solids, of which 1·8 per cent. was mannitol. A very old record by Bizio (11) gives an analysis of coconut water as 5 per cent. total solids, of which 3·825 per cent. was mannitol.

We have been able to separate mannitol quite easily from very stale coconut water, but not from fresh water. Moreover there is no unequivocal report of the occurrence of mannitol in undoubtedly fresh coconut water. At the same time all the analytical figures of which we are aware, including our own, fail to identify the 1 to 2 per cent. of organic solids other than sugars, and the subject clearly needs further investigation.

It is very difficult to preserve coconut water unchanged for any length of time; we have found chloroform and toluene quite inadequate. It seems likely that mannitol is not a normal constituent of coconut water, but is formed by bacterial reduction of glucose during putrefaction of the water on keeping. Our analytical figures in Table I show that the percentage of non-saccharine organic material increases during spontaneous fermentation, *i.e.*, the fermentable sugars present undergo side reactions other than conversion to alcohol and carbon dioxide; we consider it most probable that reduction to mannitol is one of these.

Disposal of Coconut Water on Estates.—On some Ceylon estates the water is collected in a brick-lined sump and given to cattle (12). It must be given fresh. When first fed it has a purgative effect, probably due to potash salts, but cattle become accustomed to it. Lahille (*loc. cit.*, p.16) recommends feeding the water to cattle in Indochina.

Lahille also calls attention to the desirability of conserving the water for the sake of the potash it contains. He recommends collecting the water, adding slaked lime or calcium phosphate to form a sludge which is applied directly as a fertilizer to coconut palms. The water from 1000 nuts contains about $\frac{1}{2}$ lb. K_2O.

Another plan would be to use the water for sprinkling compost heaps, which would become thereby enriched with potash, a constituent in which composts intended for manuring coconut palms are sometimes deficient.

Disposal of Water in Desiccated Coconut Factories.—In desiccated coconut factories, the accumulated washing water (which also contains the nut water) is run into settling tanks. The scum which rises is collected, and

when boiled down and pressed, yields a low grade oil, known as " drain oil " and a press cake with high fertilizer value (13). The oil almost certainly arises from the ' milk ' squeezed out from the kernels during paring and not from the nut water (14). We have extracted several samples of ripe nut water with ether and have never obtained more than traces of oil, unless the nuts were partly germinated. When germination starts, the walls of the oil-containing cells begin to break down with release of free oil. Partly germinated nuts are not, however, accepted in desiccated coconut manufacture.

It is possible that the sugar, salts and small amount of nitrogenous matter of the nut water provide a substrate for the growth of moulds and other organisms in the settling tanks which form the substance of the scum. This rises to the surface bringing with it the suspended oil. The press cake from the " drain oil ", contains a fairly high percentage of nitrogen (15).

Coconut Water as a Culture Medium.—Under field laboratory conditions in the tropics coconut water has been used as a culture medium for bacteriological work, for example by the U.S. Yellow Fever Commission in Cuba in 1890. (16). Lahille (*loc. cit.*, pp. 20–24) refers to this use, pointing out that coconut water as it comes fresh from the nut is sterile.

SUMMARY.

1. Average analytical figures for waste coconut water are recorded. From these it is concluded that the material is not a possible economic source of sugar.

2. From a preliminary study of the spontaneous fermentation of coconut water, it is concluded that it is not a promising source of alcohol.

3. Reference is made to the use of the stale acetified water as an emergency rubber coagulant.

4. The useful disposal of coconut water from copra curing on estates, and in desiccated coconut factories, is discussed.

5. Fresh sterile coconut water has been used as a laboratory culture medium.

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CHEMICAL AND AGRICULTURAL NOTES FROM THE COCONUT RESEARCH SCHEME (CEYLON)

V. COPRA FROM REJECTED COCONUT SEEDLINGS

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THE Coconut Research Scheme in Leaflet No. 2 on Nursery Management (1) recommends a very stringent selection of seedlings in the nursery. In the Scheme's own nurseries about fifty per cent. of the seedlings are rejected. These do not, however, represent quite a dead loss, since some copra can be recovered from them.

7,848 rejected seedlings from the 1946 season in the Bandirippuwa Estate nurseries, have recently been husked and split and the kernels dried in the usual way. There were obtained 3 candies 160 lb. of copra. Thus 2,388 rejected seedlings gave a candy of copra. About 1,200 of the original nuts would have given a candy of copra, so that, in spite of the seedlings being mostly over eight months old, about one half of the kernel remained.

Quality of the Copra.—Although all classed as No. 2 or 3 grade (see our article ref. 2), the copra would be expected to have a very high oil content. It has been demonstrated (3) that the surface layers, which are the first to be removed during germination, are less rich in oil than the deeper layers. Child and Pieris (4) have studied the progress of germination up to 7½ months after planting, and the kernel remaining at this stage contained 76·2 per cent. of oil on the dry weight.

We have examined two samples of copra, graded as No. 2 and No. 3 respectively, drawn from the 3 candies, 160 lb. obtained from rejected Bandirippuwa seedlings, with the following results :

	Sample of No. 2 Grade.	Sample of No. 3 Grade.
Per cent. moisture	3·7	4·1
Per cent. oil	74·3	74·7
Per cent. oil (dry weight)	77·2	77·9
F. f. a. extracted oil (per cent. lauric)	0·20	1·32
Iodine value (Wijs.)	8·7	8·1
F. f. a. pressed oil (per cent. lauric)	0·64	2·66

The copra is thus quite a satisfactory product if the kernels are well dried. It is very rich in oil, and the acidity of the oil is not unduly high. It was sold at Rs. 122 per candy (March, 1947). The cost of curing was Rs. 9·55, so the net return was Rs. 112·45 per candy; or Rs. 47·09 per 1,000 rejected seedlings.

Coconut Apples.—There is no water remaining in a nut four months after planting out in the nursery, the cavity being filled by the haustorium or coconut apple. In curing copra from the above mentioned 7,848 seedlings, the apples were rejected. We shall be reporting elsewhere investigations on the composition of coconut apples and its variations during growth.

Other Residues.—The husks had mostly lost their potash through leaching (4) and they are unsuitable for fibre manufacture. All of the remaining debris (including the husks) was therefore dried and burned.

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A GENERAL NOTE ON ESSENTIAL OILS

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ESSENTIAL oils have been prepared from ancient times but only more recently have they been isolated in their natural freshness. The three main methods by which this is done are distillation, expression, and extraction.

Steam distillation is the method most widely used and practically all types of essential oils manufactured in Ceylon are obtained by this method, which consists of the following four stages :—

Preparation of the oil containing material
Distillation
Cooling and condensation of vapours
Purification of the crude oil.

The proper preparation of the raw material is one of the most important requirements for the distillation. The raw material must be comminuted before distillation. Herbs, leaves and fresh roots are cut, barks and dry roots and fruits are ground, woods rasped and seeds crushed. Insufficient or unsuitable comminution raises the cost and decreases the yield of oil. In the case of most grasses a period of wilting *away from direct sunlight* results in the oil being liberated more easily on distillation.

Distillation is effected either (*a*) by direct heating by steam which is passed into the material either dry or suspended in water or (*b*) by indirect heating of the material in water by steam under pressure, which is made to pass through a coiled tube within the still. In certain cases the distillation is carried out with saturated steam under pressure or superheated steam. In a few cases the distillation is carried out under reduced pressure. Most oils require rapid distillation.

The vapours are made to pass through a tin-lined copper coil which is water cooled.

The oils should be rectified by redistillation but unfortunately this is never done in Ceylon.

Since steam distillation of oils depends on the physical fact that the boiling point of a mixture of two immiscible liquids (water and oil) is lower than that of the more volatile liquid (water) it would be clear that those substances that exert an appreciable vapour pressure at the boiling point of water naturally tend to be distilled. Consequently steam distilled oils do not always have the exact odour of the plant from which they are distilled, as the higher boiling odorous constituents remain to a greater or less extent undistilled.

Expression.—Oils contained in the fruit peels of oranges, limes and other citrus fruits can be obtained by hand or machine pressing. The highest grade oils are obtained by pressing the rinds against an ecuelle or a sponge which absorbs the oil. Machine pressed oils are not quite as good as hand pressed oils as the use of water causes solution losses. Expressed oils usually contain a certain amount of non-volatile matter.

Extraction.—The more delicate floral perfumes are extracted both by volatile and non-volatile solvents. Usually a non-volatile solvent, like refined lard, is used repeatedly until a high concentration of aroma is obtained and from the mixture the essential oil is extracted by alcohol to obtain the perfumes known as " ottos ".

Essential oils occur in many different parts of the plant. In some cases they are widespread as in the pine—confers, while in others they may be confined to one particular part of the plant, *e.g.*, the flower in the case of roses. The yield as a rule is small, as low as 02% for jasmine flowers, but is exceptionally high for cloves and nutmegs 8–15%. Essential oils are principally used as flavouring agents in foods and beverages, as disinfectants and in medicine and to much less extent as cosmetics and for perfumery purposes.

Finally it has to be mentioned that many essential oils undergo deterioration on prolonged keeping chiefly due to oxidation. To minimise this, essential oils should be stored in vessels of dark glass, or enamel or tin lined or aluminium containers, which should be kept covered.

SOME CEYLON FODDER BEARING TREES

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THE apathy of the Ceylon villager towards the proper housing and feeding of his livestock is generally admitted. Even in the wet zone, where natural vegetation and perennial pasture are readily available, it is not uncommon to find cattle and goats languishing for want of care and lack of sufficient food.

The conditions prevalent in the dry zone districts and semi-arid regions particularly in the Northern, North-Central, Eastern and South-eastern tracts provide much food for thought, when it is realised that in these areas, an annual set-back in the developmental progress of livestock is experienced owing to the scanty food available in these tracts during long spells of drought, not to speak of the recurrent total failure of the monsoons that leave in its wake miles and miles of parched up land devoid of a blade of grass.

This scarcity of grazing is partly alleviated by the fact that nature has provided drought-resistant trees and shrubs on the foliage and pods of which the wandering stock browse, thus helping them to tide over periods of famine.

This setback in the normal development of cattle and goats which is more or less of annual occurrence has left a stigma running through generations of our livestock resulting in their diminutive stature and poor milk production.

It is well known that famous breeds of cattle come from semi-arid regions of the world, where drought and scarcity of grazing are common features.

The Indian peasant of the cattle breeding tracts discreetly meets this state of emergency by utilizing jungle foliage, proved by experience to be of nutritive value to his stock. In this manner the naturally occurring drought-resistant trees provide a stand-by food during years of cattle food famine.

Our arboreal jungle vegetation in the dry zone is replete with a variety of shrubs and trees of fodder value that luxuriate in drought striken areas.

Though it is not the general practice among our cattle owners in the dry zones to go all out in search of loppings from these trees to feed their herds, nevertheless it is well known, that in some parts of Ceylon, as in Jaffna, Mannar and Batticaloa Districts feeding of stock with leaves of the palmyrah, Banyan and the Tulip tree is largely resorted to during lean years.

There is evidence also in the other parts of the dry zones, that villagers feed their cattle, particularly young stock and animals in milk, with foliage collected from jungle trees found palatable and nourishing to his livestock.

Invariably most of these trees are indigenous and are remarkably drought-resistant, growing under extremely xerophytic conditions and thriving, once they have attained maturity, in places where all surface grazing has been destroyed by repeated failure of the monsoons.

Attempts are now being made in more progressive cattle breeding countries to educate the farmer in the care of such trees, to prevent ruthless lopping of branches and even in introducing a programme of planting useful fodder bearing trees both indigenous and introduced.

The object of this article is to foster a sense of responsibility in our cattle-owning villager in the dry zone towards the feeding of his livestock with the produce of fodder bearing trees as a supplementary food when grazing fails.

It is also suggested that, with no hindrance to the establishment of fruit, ornamental and shade trees, the planting up or fostering to maturity of naturally-occurring fodder bearing trees should be advocated in large peasant colonization schemes in the dry zones.

Where extensive cattle breeding projects are contemplated it would be of great advantage to establish these trees or resort to selective deforestation leaving such trees to stand in large areas set apart for paddocks or grazing, as they will not only give the necessary shade for the farm animals, but will also prove to be a redoubtable source of supply of a stand-by famine fodder.

Some of these trees could be effectively grown as wind-belts, live fencing or as ornamental and shade trees along irrigation channels, streams, tank bunds and roads.

The Agricultural Department has contributed of late towards the importance of fodder–bearing trees by introducing and trying out several such species of which the Algaroba, Cashew or Masquit Bean—(*Prosopis juliflora DC*) deserves special mention. This has proved very successful and is now found to luxuriate in the dry districts of Anuradhapura, Polonnaruwa and Hambantota, yielding in profusion sweetish, succulent edible pods, relished by cattle and found to be very sustaining. A list of local and introduced fodder bearing trees, which is by no means complete is given below.

No.	Species with Local Names.	Family.	Distribution.	Description, Propagation. Areas recommended.	Parts utilized and Stock Type.
1	*Acacia arabica* Willd. (E) Gum arabic (S) Katu-andara (T) Karuvel	Mimoseae	Jaffna, Mannar, Trincomalee Districts	Shrub or small tree, grows wild. Seeds : Pasture, waste lands	Tender shoots, leaves, ripe pods : Sheep, goats
2	*Acacia eburnea* Willd. (E) Cockspur thorn (S) Gini-andara (T) Udai-vel	do.	Dry coastal regions, Jaffna, Mannar, Trincomalee, Hambantota, Puttalam Districts	Large bush or small tree, grows wild,. Seeds : Pasture, waste lands	Shoots, leaves : Sheep, goats
3	*Acacia leucophloea* Willd. (S) Maha-andara (T) Velvel	do.	Dry regions throughout the Island	Large tree. Seeds : Pasture, grasslands	Tender shoots, leaves, pods : Sheep, goats
4	*Acacia planifrons* W. & A. (E) Umbrella tree (T) Odai	do.	Abundant in Mannar, extending eastwards. Cultivated in Colombo gardens	Small tree, good fuel. Seeds : Pasture lands, gardens	Pods : Cattle, sheep, goats
5	*Acacia Sundra* D C. (E) Catechu (S) Rat-Kihiri (T) Kodalai-Murunkai	do.	Mannar, Vavuniya, Hambantota Districts	Medium size tree. Seeds : Pasture lands, waste lands	Tender shoots, leaves, ripe pods : Sheep, goats
6	*Acacia tomentosa* Willd. (E) Elephant Thorn, Jungle Nail (S) Kukul-katu (T) Anaimulli	do.	Dry regions, Jaffna, Mannar, Hambantota Districts	Small bushy tree. Seeds : Waste places	Tender shoots : Sheep, goats
7	*Adina cordifolia* Hk.f. (S) Kolon (T) Manjal Kadampa	Rubiaceae	Dry intermediate regions, Kurunegala District	Tall erect deciduous tree. Seeds : Avenues, waste places	Leaves : Cattle, sheep, goats
8	*Aegle Marmelos* Corr. (E) Bael fruit (S) Beli (T) Vilvam	do.	Wet and dry regions, mostly cultivated	Medium size tree. Seeds : gardens, waste places	Young shoots, leaves : Sheep, goats
9	*Albizzia amara* Boiv. (E) Wheel tree (T) Uyil	Leguminoseae	Northern dry regions, Mannar, Trincomalee Districts	Small much-branched tree. Seeds : Pasture, waste lands	Foliage : Cattle, sheep, goats

10	*Albizzia Lebbek* Benth. (S) Mara (T) Vakai	Leguminoseae	Dry regions, Anuradhapura District	Large tree. Seeds : Avenue, pasture	Foliage : Cattle, sheep, goats
11	*Albizzia odoratissima* Benth. (S) Suriyamara (T) Ponnaimarunkai	do.	Moist and dry zones, especially in dry low country	Very large tree. Seeds : Roadsides, pasture	Leaves : Cattle, sheep, goats
12	*Anogeissus latifolia* Wall. (S) Dawu (T) Vekkali	Combretaceae	Dry regions in open grasslands, Bintenne : Found gregarious	Small tree. Seeds : Waste areas	Leaves : Cattle, sheep, goats
13	*Artocarpus integra* Merr. (E) Jak (S) Kos (T) Pillakai	Urticaceae	Universally cultivated	Large tree. Seeds : Grafts, avenue, shade and fruit tree	Leaves, fruits : Cattle, sheep, goats
14	*Artocarpus incisa* L. (E) Bread-fruit (S) Rata-del (T) Erapillakai	do.	Cultivated, moist and dry zones	Large tree, root cuttings : gardens, avenues	Leaves, fruits : Cattle, sheep, goats
15	*Artocarpus nobilis* Thw. (E) Wild bread-fruit (S) Wal-del (T) Arsini-pilak	do.	Wild moist low country. Less common in drier regions	Very large tree. Seeds : shade, avenue	Leaves, fruits : Cattle, sheep, goats
16	*Azadirachta indica* A. Juss. (E) Margosa (S) Kohomba (T) Vempu	Meliaceae	Wild. Cultivated near homesteads in dry country	Tall massive tree. Seeds : Avenue, shade	Leaves : Cattle, sheep, goats
17	*Bambusa arundinacea* Willd. (S) Katu-una (T) Mangil	Gramineae	Warm moist regions, common along rivers	Bushy clumps. Seeds : Suckers, Channels, streams	Leaves : Cattle
18	*Madhuca Longifolia* Macbr. (S) Mi (T) Iluppai	Sapotaceae	Dry regions common. Planted in low country	Very large tree. Seeds : Avenues, gardens	Leaves, fruits, flowers : Cattle, sheep, goats
19	*Bauhinia purpurea* L. (S) Kobolila	Caesalpinieae	Warm moist regions along rivers	Shrub or small tree. Ornamental. Seeds : Gardens	Leaves : Cattle, sheep, goats

No.	Species with Local Names.	Family.	Distribution.	Description, Propagation. Areas recommended.	Parts utilized and Stock Type.
20	*Bauhinia racemosa* Lam. (S) Mayila (T) Atti	Caesalpinieae	Very common in the dry zones	Small decidous tree. Seeds : Avenues, waste places	Leaves, pods : Cattle, sheep, goats, much browzed on by elephants
21	*Gossampinus malabarica* Alst. (E) Silk cotton tree (S) Katu-imbul (T) Kadu-paruthi	Malvaceae	Moist low country and mid. elevations	Tall completely decidous tree. Seeds : Avenues, fences, gardens	Leaves, flowers : Cattle, sheep, goats
22	*Borassus flabellifer* L. (E) Palmyrah palm (S) Tal (T) Panai	Palmae	Very common, dry zone. Cultivated	Tall columnar tree, dense crown. Seeds : Gardens, avenues, waste places	Leaves, fruits : Cattle, sheep, goats
23	*Buchanania angustifolia Var. Zeylanica* Engl. (S) Kiri-palu	Anacardiaceae	Low country dry forests. Jaffna, Morawaka korale	Medium sized tree. Seeds : Avenues, pasture lands	Leaves : Cattle
24	*Butea monosperma* O. Ktze (S) Gas-kela (T) Parasu	Leguminoseae	Dry regions. Open country Jaffna, Batticaloa, Uva area, Gregarious but rare	Moderate sized tree. Seeds: Avenues, gardens, bunds	Foliage : Cattle, sheep, goats
25	*Cassia auriculata* L. (E) Tanners Cassia (S) Ranawara (T) Avary	Caesalpinieae	Dry zones very common	Shrub. Seeds : Waste places	Foliage : Sheep, goats
26	*Cassia fistula*. L. (E) Indian Laburnum (S) Ehela (T) Kavani	Leguminoseae	Dry zones very common	Moderate sized tree. Seeds : Avenues, gardens	Leaves : Cattle, sheep, goats
27	*Cassia Marginata* Roxb. (S) Ratu-wa (T) Vakai	do.	Dry regions, common	Small, wide spreading tree. Seeds : Avenues, gardens, pastures	Leaves : Cattle, sheep, goats
28	*Cassia Multijuga* Rich. (Rata-wa) (T) Vakai	do.	Dry and moist regions. Common Anuradhapura	Moderate sized tree. Seeds Cuttings : avenues, gardens	Leaves : Cattle, sheep, goats

29	*Cassia siamea* Lam. (S) Wa, Aramana (T) Vakai	Leguminoseae	Moist country, low and mid-elevations. Common near streams	Medium sized tree. Seeds : Avenues, gardens	Leaves : Cattle, sheep, goats
30	*Canthium coromandelicum* Alst. (S) Kara (T) Karai	Rubiaceae	Dry low country	Small tree. Seeds : Gardens, avenues	Leaves : Cattle, sheep, goats
31	*Ceiba pentandra* Gaertn. (E) Kapok, Silk Cotton (S) Pulung, kotta-pulung (T) Panchchi	Malvaceae	Wet and dry zones	Tall erect tree. Seeds, stumps: avenues, fences, gardens, waste places	Leaves, Cattle, sheep, goats. Seeds : Cattle
32	*Cordia domestica* Roth. (E) Sebestens (S) Lolu (T) Naruvili	Boragineae	Dry zones, sometimes cultivated: Kurunegala, Hambantota Districts	Large bush or small tree. Seeds : Avenues, gardens	Leaves : Cattle, sheep, goats
33	*Dalbergia lanceolaria* L. f. (S) Bol-mara (T) Veluruvai	Leguminoseae	Dry, North-east and south-west regions	Tall erect tree . Seeds : Pasture, waste lands	Leaves : Cattle, sheep, goats
34	*Dalbergia Sissoo* Roxb.	do.	Arid regions	Moderate sized tree. Seeds : Gardens, waste places	Leaves : Cattle, sheep, goats
35	*Dichrostachys cinerea* W & A. (S) Andara (T) Vidattal	do.	Low country dry zones	Bush or small tree. Seeds : Fences, waste places	Leaves, pods : Sheep, goats
36	*Elaeodendron glaucum* Pers. (S) Neralu (T) Piyari	Celastraceae	Dry country	Small tree. Seeds : Avenues, shade tree	Leaves : Cattle, sheep, goats
37	*Enterolobium saman* Prain. (E) Rain-tree (S) Mara (T) Vakai	Leguminoseae	Both moist and dry regions	Large spreading tree. Seeds : Avenues, gardens	Leaves, pods : Cattle' sheep, goats
38	*Erythrina fusca* Lour. (S) Yak-erabadu	do.	Dry zones, near streams	Small tree. Seeds, stumps : Gardens, tank bunds, along water channels	Leaves : Cattle, sheep, goats

No.	Species with Local Names	Family.	Distribution.	Description, Propagation. Areas recommended.	Parts utilized and Stock Type.
39	*Erythrina lithosperma* Miq. (E) Dadap (S) Erabadu (T) Mullu-murukku	Leguminoseae	Both moist and dry country. Usually wet zone	Medium size. Seeds, stumps : Gardens, fences	Leaves : Cattle, sheep, goats
40	*Erythrina variegata* L. (S) Erabadu (T) Mullu-marukku	do.	Cultivated in gardens	Small tree. Seeds, stumps : Gardens, fences	Leaves : Cattle, sheep, goats
41	*Syzygium cumini* Skeels. (E) Black-plum (S) Ma-dan (T) Perum-naval	Myrtaceae	Moist low country, especially dry regions	Large tree. Seeds : Avenue, shade and fruit tree	Leaves : Cattle, sheep, goats
42	*Limonia acidissima* L. (E) Wood-apple (S) Divul (T) Vilar	Rutaceae	Very common in dry country Also found in the wet zones	Moderate sized erect tree. Seeds : Gardens, waste places	Leaves : Sheep, goats
43	*Ficus benghalensis* L. (E) Banyan tree (S) Maha-nuga (T) Al	Urticaceae	Low country, especially in dry regions	Very large spreading, evergreen tree. Seeds, stumps : Avenues, gardens, shade tree	Foliage, fruits : Cattle, sheep, goats
44	*Ficus glomerata* Roxb. (E) Wild fig (S) Attika (T) Atti	do.	Moist low country. Not common in the dry zones	Moderately large tree. Seeds, stumps : Avenue, shade tree	Leaves : Cattle, sheep, goats
45	*Ficus religiosa* L. (E) Sacred Bo-tree (S) Bo (T) Arasu	do.	Both moist and dry country	Large spreading, decidous tree. Seeds, stumps : Avenues, shade tree	Foliage : Cattle, sheep, goats
46	*Ficus retusa* L. (S) Panu-nuga (T) Itti	do.	Moist low country and dry regions	Large evergreen shady tree. Seeds, stumps : Avenue and shade tree	Leaves : Cattle, sheep, goats

47	*Ficus Tsiela* Roxb. (S) Ela-nuga, Ehetu (T) Kalatti	Urticaceae	Dry and intermediate regions	Tall, spreading tree. Seeds, stumps : Avenue and shade tree	Foliage : Cattle, sheep, goats
48	*Gmelina arborea* Roxb. (S) Et-demata (T) Gumudu-Takku	Verbenaceae	Moist regions	Large spreading tree. Seeds : Avenues, gardens	Leaves, fruits : Cattle, sheep, goats
49	*Gmelina asiatica* L. (S) Demata (T) Kumil	do.	Common in low country	Much branched bush. Seeds : Open places	Leaves, fruits : Cattle, sheep, goats
50	*Gliricidia sepium* Stend. (E) Madera (S) Wetahira	Leguminoseae	Wet and dry zones	Quick growing, small tree. Seeds, stumps : Avenues, gardens, fences	Leaves : Cattle, sheep, goats
51	*Grewia polygama* Roxb. (S) Bora-daminiya (T) Thavattai	Tiliaceae	Common in dry country, Anuradhapua and eastwards	Moderate sized tree. Seeds : Waste places	Leaves : Cattle, sheep, goats
52	*Grewia tiliaefolia* Vahl. (S) Daminiya (T) Chadachchi	Tiliaceae	Low country	Moderate sized tree with spreading crown. Seeds : Avenue and shade tree	Leaves : Cattle, sheep, goats
53	*Guazuma ulmifolia* Lamk.	do.	Dry districts, occasionally planted	Small tree or shrub. Seeds : Avenues, gardens, hedges	Leaves : Cattle, sheep, goats
54	*Hemicyclia sepiaria* W. & A. (S) Wira (T) Virai	Euphorbiaceae	Dry zone	Moderately large tree. Seeds : Avenues, pasture	Leaves : Cattle, sheep, goats
55	*Holoptelea integrifolia* Planch. (E) Indian Elm (S) Goda-kirilla (T) Velayil	Urticaceae	Dry regions, common	Large, decidous tree. Seeds : Avenues, pastures, waste places	Leaves, young pods : Cattle, sheep, goats
56	*Lagerstroemia speciosa* Pers. (E) Pride of India (S) Muruta (T) Pumaratu	Lythraceae	Common near rivers in wet country. Scarce in dry regions	Fairly large decidous tree. Seeds : Avenues, gardens, along channels and streams	Leaves : Cattle, sheep, goats

No.	Species with Local Names.	Family.	Distribution.	Description, Propagation. Areas recommended.	Parts utilized and Stock Type.
57	*Leucaena glauca* Benth. (E) Wild-or Horse Tamarind	Leguminoseae	Wet and dry districts	Quick growing, small hardy tree. Seeds: Fences, wind-belts, waste places	Leaves seeds: Cattle, sheep, goats
58	*Mangifera indica* L. (E) Mango (S) Amba (T) Mangai	Anacardiaceae	Wet and dry districts	Large tree. Seeds, grafts: gardens, pasture, shade and fruit tree	Leaves, fruits: Cattle, sheep, goats
59	*Mangifera zeylanica* Hk. f. (E) Wild mango (S) Etamba, walamba (T) Kaddu-mangai	do.	Wet and dry zones	Massive spreading tree. Seeds: Pasture, waste lands	Leaves, fruits: Cattle, sheep, goats
60	*Mimusops Elengi* L. (S) Munamal (T) Mukalai	Sapotaceae	Fairly common in the dry zone	Very large tree with dense crown. Seeds: Avenues, pastures	Leaves, fruits: Cattle, sheep, goats
61	*Manilkara hexandra* Dubard. (S) Palu (T) Talai	do.	Found abandontly in the dry zone	Very large tree. Seeds: Avenues, pastures	Leaves, fruits: Cattle, sheep, goats
62	*Morinda tinctoria* Roxb. (S) Ahu (T) Manchavanna	Rubiaceae	Dry zones. Common in Jaffna, Trincomalee, Anuradhapura and Uva	Small tree. Seeds: Waste places	Leaves: Cattle, sheep goats
63	*Moringa oleifera* Lamk. (E) Drum-stick, Horse-Radish tree (S) Murunga (T) Murunga-kai	Moringeae	Cultivated throughout. Thrives best in dry zones	Small tree. Seeds, stumps: Gardens, fences	Tender shoots, leaves: Cattle, sheep, goats
64	*Muntingia Calabura* L. (E) Jam-fruit (S) Jam-fruit gaha	Tiliaceae	Both wet and dry zones. Mostly planted	Medium sized spreading ornamental tree. Seeds, cuttings: gardens, avenues, pasture lands	Leaves, fruits: Cattle, sheep, goats
65	*Lannea grandis* Engl. (S) Hik (T) Odi	Anacardiaceae	Dry and moist low country, especially dry forests	Small decidous tree. Seeds: Avenues, gardens	Leaves: Cattle, sheep, goats

66	*Peltophorum inerme* Naves. (T) Iya-vakai	Caesalpiniae	Both moist and dry country	Handsome, large, quick-growing tree. Seeds: avenues, gardens	Leaves: Cattle, sheep, goats
67	*Pithecolobium dulce* Benth. (E) Madras thorn (S) Katu-andara	Leguminoseae	Low and mid country	Large tree, Seeds: Fences, avenues, waste places	Leaves, pods: Cattle, sheep, goats
68	*Pongamia pinnata* Merr. (S) Magul-karanda (T) Punku	do.	Low country, along streams. Common in coastal districts and near tanks in the dry zones	Moderately large tree. Seeds: Avenue, waste places, shade tree	Foliage: Cattle, sheep, goats
69	*Prosopis Juliflora* Dc. (E) Algaroba Bean	do.	Dry zones	Medium size tree. Seeds: Avenues, fences, waste places, pasture lands	Leaves, shoots, pods: Cattle, sheep, goats
70	*Pterocarpus. Marsupium* Roxb. (S) Gamalu (T) Venkai	do.	Low and intermediate dry regions. Moist regions, rare	Small tree. Seeds: Gardens, avenues	Leaves: Cattle, sheep, goats
71	*Salvadora persica* L. (E) Mustard tree (S) Malittan (T) Uvay	Salvadoraceae	Dry zone, particularly arid regions. Hambantota district	Small tree. Seeds: Avenue, gardens	Leaves: Cattle, sheep, goats
72	*Schleichera oleosa* Merr. (E) Ceylon oak (S) Kon (T) Kula	Sapindaceae	Dry and moist low country	Large tree. Seeds: Avenues, pasture lands	Leaves: Cattle, sheep, goats
73	*Sesbania aegyptiaca* Poir.	Leguminoseae	Dry regions	Shrub. Seeds; Gardens, fences	Leaves: Cattle, sheep, goats
74	*Sesbania grandiflora* Pers. (S) Katuru-murunga (T) Agathi	do.	Dry and moist low country	Small tree. Seeds: Gardens, fences, wind-breaks	Leaves, flowers, green pods: Cattle, sheep, goats

No.	Species with Local Names.	Family.	Distribution.	Description, Propagation. Areas recommended.	Parts utilized and Stock Type.
75	*Streblus asper* Lour. (S) Geta-netul (T) Pirasu	Urticaceae	Common in mid-dry zone	Moderate sized tree. Seeds : Garden, hedge or boundary plant	Leaves, : Cattle, sheep, goats
76	*Strychnos potatorum* L. f. (E) Clearing nut-tree (S) Ingini (T) Tetta-Kottai	Loganiaceae	Dry and in intermediate zones	Moderate sized tree. Seeds : Avenues, pastures lands	Leaves : Cattle, sheep, goats
77	*Tamarindus indica* L. (E) Tamarind (S) Siyambala (T) Puli	Caesalpinieae	Wet and dry zones	Very large tree with spreading branches. Seeds : Avenues, pasture lands	Young shoots, leaves, pods : Sheep, goats
78	*Terminalia belerica* Roxb. (S) Bulu (T) Tanti	Combretaceae	Wet and intermediate zones	Tall stately tree. Seeds : Avenues, pasture lands waste places	Leaves : Cattle, sheep, goats
79	*Terminalia Arjuna* W. & A. (S) Kumbuk (T) Marutu	do.	Dry and wet zones. Common along streams and tanks	Huge water loving tree. Seeds : Tank bunds, river and stream banks	Leaves : Sheep, goats
80	*Thespesia populnea* Soland. (E) Tulip tree (S) Suriya (T) Kavarachu	Malvaceae	Plentiful in sea coasts, and dry districts	Moderate sized spreading tree. Seeds, stumps : Fences, avenues waste places, pasture lands	Leaves : Cattle, sheep, goats
81	*Cedrela Toona* rox b (E) Indian mahogany (S) Red cedar (T) Handani, Vembu	Meliaceae	High elevation tea estates	Moderately large tree. Seeds : Gardens, avenue and shade tree	Young shoots, leaves : Cattle, sheep, goats
82	*Ziziphus jujuba* Lam. (E) Stone-apple (S) Masan-Maha-debara (T) Ilantai	Rhamnaceae	Dry zones	Large shrub or small tree. Seeds, Grafts : avenues waste places, gardens	Leaves : Sheep and goats

BOTANICAL CHARACTERS OF PADDY

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BOTANICAL CHARACTERS.

1.	Selection	.. 2462/11 Pachchaiperumal
		Observations soon after 50 per cent. flower.
2.	Leaf ..	.. Green
3.	Leaf Sheath	.. Greenish white with faint purple streaks
4.	Auricle	.. Pale white, hairy
5.	Ligule	.. Pale white, lanceolate
6.	Stigma	.. Dark purple
7.	Apiculus	.. Purple
8.	Glumes : Fertile	.. Yellow with green ridges
	Infertile	.. Greenish white
		Observations a fortnight after 50 per cent. flower.
9.	Flag leaf	.. Erect
10.	Peduncle exsertion	.. Short
11.	Panicle	.. Spreading and curving
		Observations at harvest.
12.	Awns	.. Nil
13.	Grain	.. Fairly long and bold
14.	Glumes : Fertile	.. Dark brown furrows and light brown ridges
	Infertile	.. Pale white
15.	Testa	.. Red

Age : 3–3½ months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	.. 38 YM 2208 Sinnanayan
		Observations soon after 50 per cent. flower.
2.	Leaf ..	.. Dark green, rough surface, thick
3.	Leaf Sheath	.. Pale white with purple streaks at base and yellowish green with light purple streaks at top
4.	Auricle	.. Pale white, long, hairy, sickle shaped
5.	Ligule	.. Pale white with light purple streaks, medium splitting
6.	Stigma	.. Purple
7.	Apiculus	.. Maroon
8.	Glumes : Fertile	.. Yellowish green
	Infertile	.. White with green at base
		Observations a fortnight after 50 per cent. flower.
9.	Flag leaf	.. Erect
10.	Peduncle exsertion	.. Short
11.	Panicle	.. Compact and semi-curving.

Observations at harvest.

12.	Awns	..	Nil
13.	Grain	..	Medium, bold
14.	Glumes : Fertile	..	Dark brown with light brown ridges
	Infertile	..	Straw coloured
15.	Testa	..	Red

Age : 3½–4 months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	..	26014 Perillanel

Observations soon after 50 per cent. flower.

2.	Leaf ..	..	Light green
3.	Leaf Sheath	..	Pale green
4.	Auricle	..	Pale white with a tint of purple
5.	Ligule	..	Pale white with purple streaks
6.	Stigma	..	Purple
7.	Apiculus	..	Light purple, prominent
8.	Glumes : Fertile	..	Light green
	Infertile	..	Greenish white

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	..	Erect
10.	Peduncle exsertion	..	Medium
11.	Panicle	..	Spreading and curving

Observations at harvest.

12.	Awns	..	Nil
13.	Grain	..	Long and fairly bold
14.	Glumes : Fertile	..	Light straw colour
	Infertile	..	Brownish white
15.	Testa	..	Red

Age : 4 months.
Season : Maha.

BOTANICAL CHARACTERS.

1.	Selection	..	a-8 Podiwi

Observations soon after 50 per cent. flower.

2.	Leaf ..	..	Greenish
3.	Leaf Sheath ..		Purple green
4.	Auricle	..	Pale white, hairy
5.	Ligule	..	Pale white
6.	Stigma	..	Purple
7.	Apiculus	..	Purple
8.	Glumes : Fertile	..	Greenish yellow
	Infertile		White with green at base

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	..	Erect
10.	Peduncle exsertion	..	Short
11.	Panicle	..	Fairly compact and semi-curving

Observations at harvest.

12.	Awns	..	Nil
13.	Grain	..	Short and definitely bold
14.	Glumes : Fertile	..	Yellowish cream buff.
	Infertile	..	Brownish white
Testa ..		..	White

Age : 5–6½ months.
Season : Maha.

BOTANICAL CHARACTERS.

1.	Selection	Hf–9, Suduheenati

Observations soon after 50 per cent. flower.

2.	Leaf ..	Light green
3.	Leaf Sheath	Pale green
4.	Auricle	Pale white, short
5.	Ligule	Pale white, medium
6.	Stigma	White
7.	Apiculus	White prominent
8.	Glumes : Fertile	Greenish white with green ridges
	Infertile	Greenish white

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	Erect
10.	Peduncle exsertion	Short
11.	Panicle	Fairly compact and semi-curing

Observations at harvest.

12.	Awns	Terminal, short
13.	Grain	Medium and fairly bold
14.	Glumes : Fertile	Cream buff
	Infertile	Pale white
15.	Testa	Red

Age : 3½–4 months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	28061 Vellai illankalayan

Observations soon after 50 per cent. flower.

2.	Leaf ..	Dark green
3.	Leaf Sheath	Pale green with light purplish streaks
4.	Auricle	Pale white, medium
5.	Ligule	Pale white
6.	Stigma	Dark purple
7.	Apiculus	Purple prominent
8.	Glumes : Fertile	Yellowish green
	Infertile	White with green at base

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	Erect
10.	Peduncle exsertion	Medium
11.	Panicle	Spreading and drooping

Observations at harvest.

12.	Awns	Incipient
13.	Grain	Long and fairly bold
14.	Glumes : Fertile	Straw colour with light brownish shade
	Infertile	Pale brownish white
15.	Testa	Red

Age : 4–4½ months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	2449/20 Oddavalan

Observations soon after 50 per cent. flower.

2.	Leaf ..	Green
3.	Leaf Sheath	Pale green, with purple streaks
4.	Auricle	Pale white, short
5.	Ligule	Pale white with purple tint, medium
6.	Stigma	Dark purple
7.	Apiculus	Purple
8.	Glumes : Fertile	Greenish white
	Infertile	White with green at base

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	Erect
10.	Peduncle exsertion	Short
11.	Panicle	Compact and semi-curving

Observations at harvest.

12.	Awns	Nil
13.	Grain	Fairly long and bold
14.	Glumes : Fertile	Dark snuff brown furrows and brown ridges
	Infertile	Pale white
15.	Testa	Red

Age : $3\frac{2}{3}$–$4\frac{1}{4}$ months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	b–13 Kurulutuduwi

Observations soon after 50 per cent. flower.

2.	Leaf ..	Green
3.	Leaf sheath	Light green
4.	Auricle	Pale white, hairy
5.	Ligule	Pale white, linear, medium
6.	Stigma	White
7.	Apiculus	Greenish white
8.	Glumes : Fertile	Yellowish green with greenish ridges
	Infertile	Greenish white

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	Erect
10.	Peduncle exsertion	Medium
11.	Panicle	Compact and drooping

Observations at harvest.

12.	Awns	Nil
13.	Grain	Long and bold
14.	Glumes : Fertile	Yellowish cream buff
	Infertile	White
15.	Testa ..	White

Age : $5\frac{1}{4}$–6 months.
Season : Maha

BOTANICAL CHARACTERS.

1.	Selection	.. 26081 Dewareddiri

Observations soon after 50 per cent. flower.

2.	Leaf ..	.. Green
3.	Leaf Sheath	.. Pale green
4.	Auricle	.. Pale white
5.	Ligule	.. Pale white
6.	Stigma	.. White
7.	Apiculus	.. White prominent
8.	Glumes : Fertile	.. Greenish white
	Infertile	.. White with green at base

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	.. Erect
10.	Peduncle exsertion	.. Short
11.	Panicle	.. Compact and drooping

Observations at harvest.

12.	Awns	.. Terminal, short
13.	Grain	.. Fairly long and bold
14.	Glumes : Fertile	.. Dark brownish straw colour
	Infertile	.. Pale brownish white
15.	Testa	.. Red

Age : $5\frac{1}{2}$–6 months.
Season : Maha.

BOTANICAL CHARACTERS.

1.	Selection	.. 1 Cpy–19 Suduheenati

Observations soon after 50 per cent. flower.

2.	Leaf ..	.. Light green
3.	Leaf sheath	.. Pale green
4.	Auricle	.. Pale white, short
5.	Ligule	.. Pale white, medium
6.	Stigma	.. White
7.	Apiculus	.. White prominent
8.	Glumes : Fertile	.. Greenish yellow
	Infertile	.. Greenish white

Observations a fortnight after 50 per cent. flower.

9.	Flag leaf	.. Erect
10.	Peduncle exsertion	.. Short
11.	Panicle	.. Spreading and semi-curving

Observations at harvest.

12.	Awns	.. Nil
13.	Grain	.. Medium and fairly bold
14.	Glumes : Fertile	.. Dark brown furrows and light brown ridges
	Infertile	.. Pale white
15.	Testa	.. Red

Age : $3\frac{2}{3}$–$4\frac{1}{2}$ months.
Season : Maha and yala.

BOTANICAL CHARACTERS.

1.	Selection	B-11 Mawi
		Observations soon after 50 per cent. flower.
2.	Leaf ..	Green
3.	Leaf sheath	Pale green
4.	Auricle	Pale white, hairy, sickle shaped, medium
5.	Ligule	Pale white, linear, medium
6.	Stigma	White
7.	Apiculus	White prominent
8.	Glumes : Fertile	Greenish white with green ridges
	Infertile	White with green at base
		Observations a fortnight after 50 per cent. flower.
9.	Flag leaf	Erect
10.	Peduncle exsertion	Medium
11.	Panicle	Lightly spreading and drooping
		Observations at harvest.
12.	Awns	Nil
13.	Grain	Long and bold
14.	Glumes : Fertile	Snuff brown furrows with yellow ridges
	Infertile	Pale white
15.	Testa	Red

Age : 5½–6 months.
Season : Maha.

BOTANICAL CHARACTERS.

1.	Selection	37 YM 2014 Dahanala
		Observations soon after 50 per cent. flower.
2.	Leaf ..	Light green, smooth and velvety, medium thickness
3.	Leaf sheath	Yellowish green with purple streaks
4.	Auricle	Pale white, medium, hairy
5.	Ligule	Pale white, medium, splitting
6.	Stigma	Purple
7.	Apiculus	Yellowish green with light pinkish tip
8.	Glumes : Fertile	Yellowish green
	Infertile	White with yellowish green at base
		Observations a fortnight after 50 per cent. flower.
9.	Flag leaf	Erect
10.	Peduncle exsertion	Nil
11.	Panicle	Spreading and curving
		Observations at harvest.
12.	Awns	Nil
13.	Grain	Fairly long and bold
14.	Glumes : Fertile	Black
	Infertile	Straw coloured
15.	Testa	Light red

Age : 3–3½ months.
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1. Selection .. 38 YM 3753 Rathkarayal

Observations soon after 50 per cent. flower.

2. Leaf .. .. Dark green
3. Leaf sheath .. Yellowish green with purplish streaks at base and green streaks at top
4. Auricle .. Long, hairy, sickle shaped
5. Ligule .. Pale white and long
6. Stigma .. Purple
7. Apiculus .. Maroon
8. Glumes : Fertile .. Yellowish green with green ridges
   Infertile .. Pale white with green at base

Observations a fortnight after 50 per cent. flower.

9. Flag leaf .. Erect
10. Peduncle exsertion .. Short
11. Panicle .. Compact, semi-curving

Observations at harvest.

12. Awns .. Nil
13. Grain .. Medium and bold
14. Glumes : Fertile .. Dark brown with light brown ridges
    Infertile .. White
15. Testa .. Light red

Age : 3½–4 months.
Season : Maha and yala.

BOTANICAL CHARACTERS.

1. Selection .. 38 MY 137 Madael

Observations soon after 50 per cent. flower.

2. Leaf .. .. Green, thick and fairly rough
3. Leaf sheath .. Light green
4. Auricle .. Pale white, small
5. Ligule .. Pale white, medium
6. Stigma .. White
7. Apiculus .. White prominent
8. Glumes : Fertile .. Whitish green
   Infertile .. White and green at base

Observations a fortnight after 50 per cent. flower.

9. Flag leaf .. Erect
10. Peduncle exsertion .. Short
11. Panicle .. Compact and erect

Observations at harvest.

12. Awns .. Nil, and Awned
13. Grain .. Long and fairly bold
14. Glumes : Fertile .. Light brown darkening towards apicule
    Infertile .. Pale white
15. Testa .. Red

Age : 4–4½ months ..
Season : Maha and Yala.

BOTANICAL CHARACTERS.

1.	Selection	.. 39 YM 3254 Kaluheenati
		Observations soon after 50 per cent. flower.
2.	Leaf ..	.. Dark, green, thick
3.	Leaf sheath	.. Pale green with purple tinge darker at base
4.	Auricle	.. Pale whitish brown, medium
5.	Ligule	.. Papery whitish, medium, lanceolate
6.	Stigma	.. White with light purplish tinge at base
7.	Apiculus	.. Creamish
8.	Glumes : Fertile	.. Light green with deep furrows of darker shade
	Infertile	.. Light green
		Observations a fortnight after 50 per cent. flower.
9.	Flag leaf	.. Erect
10.	Peduncle exsertion	.. Short
11.	Panicle	.. Compact and slightly curving
		Observations at harvest.
12.	Awns	.. Nil
13.	Grain	.. Medium and bold
14.	Glumes : Fertile	.. Blackish brown
	Infertile	.. Light blackening brown
15.	Testa	.. Dark rose red

Age : 3–3½ months.
Season : **Maha and yala.**

NOTES ON THE MANURING OF COCONUT PALMS*

BY

M. L. M. SALGADO, Ph.D. (Cantab.), B.Sc. (Lond.), Dip. Agric. (Cantab.)

SOIL CHEMIST, COCONUT RESEARCH SCHEME, CEYLON

1. RESULTS OF EXPERIMENTS.

THE results of the field experiments and laboratory investigations on which manurial recommendations are made will be first considered. These include, among others, an experiment on a comparatively good soil at Bandirippuwa Estate that had been regularly manured, and two field experiments on poor lateritic (cabooky) soils at Veyangoda and Ahangama.

(*a*) *Experiment at Bandirippuwa Estate : Good Soil.*—This was laid down in November, 1935, and the following conclusions can be drawn :—

(i.) *Phosphoric Acid.*—In no year has phosphoric acid given an increase in yield. Analyses of soil samples taken in 1935 before manuring showed that there was a considerable accumulation of available phosphoric acid in the manure circles as a result of previous manuring. Even after a period of 8 years, during which no phosphoric acid was applied, the reserves of this constituent were found to be sufficient.

(ii.) *Nitrogen.*—In the second year after the first manuring nitrogen gave a highly significant increase. In most of the subsequent years nitrogen applied at the rate of 0·5 lb. per palm produced an increase, which however, was not statistically significant in some years, whereas a higher dose of 1 lb. per palm depressed this increase of yield. There was little difference between inorganic nitrogen manures, such as cyanamide and organic manures, such as groundnut cake in their effect on yield.

(iii.) *Potash.*—Potash applied at the rate of 0·75 lb. per palm produced a significant response only in the fifth year after the first manuring. With the higher dose of 1·5 lbs. potash per palm a significant increase was produced in the third year. The response to both single and double doses of potash has been progressively increasing and reached a peak in the seventh year.

Manures were applied once in two years.

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*Leaflet No. 12, Coconut Research Scheme, Ceylon.

The following Table summarises the increases of yield due to potash manuring :—

Lbs. Copra per Acre.

Year after 1st Manuring.	Increase due to 0·75 lb. potash per palm.	Increase due to 1·5 lbs. potash per palm.
1936—1st year	26 (not significant)	50 (not significant)
1937—2nd ,,	47 do.	80 do.
1938—3rd ,,	47 do.	114 do.
1939—4th ,,	28 do.	120 do.
1940—5th ,,	190	249
1941—6th ,,	122	196
1942—7th ,,	352	470
1943—8th ,,	300	407
1944—9th ,,	362	546
Total (9 years)	1,474	2,232
Average per annum	163	248

Under the conditions of the experiment, potash is the dominant manurial requirement of coconut palms. Compared to nitrogen, which showed a maximum increase of 8 per cent., potash has given increases of as much as 25 per cent. for the smaller rate of application and 39 per cent. for the higher.

Palms in plots receiving no potash show visible signs of potash deficiency in the foliage and the crown.

(*b*) *Experiments at Veyangoda and Ahangama: Poor Soils.*—In contrast to the soil of the above experiment the soils of these two experiments consist of extremely poor lateritic gravel, with little reserves of plant food, subject always to heavier rainfall. In fact both these estates had not been manured for almost a decade before the commencement of the experiment.

In comparison with the results of manuring obtained in the experiment at Bandirippuwa, the yield increases observed in these two experiments have been more spectacular as shown by the data below :—*

The following points became apparent from the above two tables :—

(i) A marked response to manuring is obtained on these poor soils, in contrast to that on good soils ;

(ii.) *Phosporic Acid produces a distinct response*, which is almost spectacular considering the small amount of phosphoric acid added. In fact absence of phosphoric acid forms a definite limiting factor to the response of added nitrogen and potash. Those soils contained only traces of available phosphate ; and

(iii.) an appreciable improvement was obtained in the copra out-turns.

*** Ahangama—Southern Province—Manure first applied April, 1939 and subsequently once in two years.**

Treat-ments.	1st Year, 1939–1940. Nuts per Acre.	Lbs. Copra p. Ac.	%	Copra out-turn	2nd Year, 1940–1941. Nuts per Acre.	Lbs. Copra p. Ac.	%	Copra out-turn	3rd Year, 1941–1942. Nuts per Acre.	Lbs. Copra p. Ac.	%	Copra out-turn	4th Year, 1942–1943. Nuts per Acre.	Lbs. Copra p. Ac.	%	Copra out-turn	5th Year, 1943–1944. Nuts per Acre.	Lbs. Copra p. Ac.	%	Copra out-turn.
0	1148	478	100	1344	714	299	100	1338	920	408	100	1264	1197	508	100	1320	1100	476	100	1295
NK	1142	490	103	1306	1203	562	188	1197	1771	809	199	1225	1558	744	146	1173	1646	774	162	1190
NPK	1281	553	116	1299	1329	627	210	1187	2108	998	245	1183	2297	1073	211	1199	2280	1096	230	1165
NPK-0	133	75	16	45	615	328	110	151	1188	590	145	81	1100	565	111	121	1180	620	130	130

Veyangoda—Manures first applied December, 1939.

	1940.				1941.				1942.				1943.				1944.			
0	688	246	100	1569	433	166	100	1465	932	343	100	1524	656	233	100	1579	394	161	100	1367
NK	604	221	90	1530	544	237	143	1300	1232	491	143	1404	840	318	136	1480	391	179	111	1225
NPK	611	228	83	1503	584	258	155	1270	1669	699	204	1336	1721	672	288	1435	1393	642	397	1216
NPK-0	–77	–18	–17	–66	151	92	55	195	737	356	104	188	1065	439	188	144	999	481	297	151

0 = No manure ; NK = Nitrogen and Potash ; NPK = Nitrogen, Potash and Phosphate ;
N = 0·6 lbs. per palm ; K = 1 lb. per palm ; P = 0·6 lbs. per palm.

2. AVAILABLE MANURES.

Now that the war is over inorganic nitrogen manures such as calcium cyanamide and sulphate of ammonia, which are much cheaper than organics such as groundnut cake and fishmeal, should be soon available for coconut manuring.

Manure firms supply price lists of manures in stock, stating also their compositions. In comparing the cost of manures, the unit values or the cost per ton divided by the percentage value of the manurial ingredient should be considered. Similarly in compounding manure mixtures the cost per palm should be kept in mind, as distinct from cost per ton.

It should be noted that muriate of potash now available contains 60 per cent. potash and not 50 per cent. as in the pre-war material.

The best use should be made of locally available materials of manurial value, regarding, which information will be found in Leaflet No. 9.

3. MANURE MIXTURES.

On the basis of the discussion in Section 1, the following recommendations are made for the manuring of bearing coconut palms :—

Nitrogen.—An application of *0·5 lb. Nitrogen* per palm would be considered sufficient. Excess nitrogen should be avoided.

Phosphoric Acid.—We note from our advisory correspondence that an entirely wrong impression has been created that we have been discouraging the use of phosphates in coconut estates. The fact is that, as a result of our experiments we are in a position to recommend the judicious and economical use of phosphoric acid in manuring coconuts. These recommendations are as follows :—

(*a*) Where heavy applications of phosphoric acid have been made, such as those used in the old type of manure mixtures amounting to 4 to 5 lbs. bonemeal per palm, sufficient reserves of phosphoric acid have been found to be maintained for a number of years, so that no further response to phosphoric acid is produced for sometime. In such cases, application of phosphates may be omitted for two or three manuring cycles (say 4 to 6 years).

(*b*) Where no manuring has been done for 4 or 5 years, *more particularly in lateritic and gravelly soils*, phosphoric acid produces a response, but a small rate of application is considered sufficient. An application of *0·6 lb. phosphoric* acid equivalent to 2 lbs. saphos phosphate or 2½ lbs. bonemeal per palm would be suitable.

Potash.—*1 lb. potash* per palm would be an economic dose for most soils. In potash deficient soils such as cinnamon soils marine sands as in the Puttalam district littoral, and lateritic soils and gravels it may even be increased to 1·5 lbs. per palm.

Subject to the modifications suggested above, the following mixtures can be recommended to suit present conditions ; owing to the uncertain nature

of the available stocks of manures and of changing prices, it would be advisable, specially till normal conditions return, that planters consult us on the mixtures they propose to apply :—

(*a*) Sulphate of Ammonia	.. 3 lbs.	per palm
Saphos phosphate	.. 2 ,,	
Muriate of potash (60 per cent.)	.. 2 ,,	
	7 ,,	

Ash or lime should never be added to mixtures containing sulphate of ammonia.

(*b*) Calcium cyanamide	.. 3 lbs.	per palm
Saphos phosphate	.. 2 ,,	
Muriate of potash (60 per cent.)	.. 2 ,,	
	7 ,,	

Only in case sulphate of ammonia and calcium cyanamide are not available, can the following mixtures consisting of " organics " be recommended. The latter are relatively more expensive per palm, though apparently cheaper per ton.

(*c*) Groundnut cake ..	.. 7 lbs.	per palm
Saphos phosphate	.. 2 ,,	
Muriate of potash (60 per cent.)	.. 2 ,,	
	11 ,,	

(*d*) Crushed fish ..	.. 13 lbs.	per palm
Muriate of potash (60 per cent.)	.. 2 ,,	
	15 ,,	

(*e*) Groundnut cake	.. 3½ lbs.	per palm
Crushed fish ..	.. 6½ ,,	
Saphos phosphate	.. 1 ,,	
Muriate of potash (60 per cent.)	.. 2 ,,	
	13 ,,	

(*f*) Fish guano ..	.. 7 lbs.	per palm
Saphos phosphate	.. 1 ,,	
Muriate of potash (60 per cent.)	.. 2 ,,	
	10 ,,	

(*g*) *Cattle Manure.*—Where palms are manured by tethering a pair of cattle for a week, the following manures or their equivalent should be added :—

Saphos phosphate	.. 1½ lbs.	per palm
Muriate of potash (60 per cent.)	.. 1 ,,	
	2½ ,,	

(*h*) *Goat Manure :—*

Goat manure	.. 28 lbs.	per palm
Saphos phosphate	.. 1½ ,,	
Muriate of potash (60 per cent.)	.. 1½ ,,	
	31 ,,	

The above rates of application are to be used once in two years. Half the quantity may be used if manured annually—See Sec. 7.

(i.) *Manuring Land under Cover Crops.*—In an experiment on the manuring of land under cover crops at Bandirippuwa Estate it was found that a complete mixture containing nitrogen, phosphoric acid and potash gave the best results. It is known that leguminous cover crops take up a considerable amount of phosphoric acid, Absence of potash produced a big drop in yield and here again the importance of potash for coconut manuring has been demonstrated.

Manure mixtures *a* and *b* of section 3 may be used, the quantities per palm being applied for each square.

The manure mixture is broadcast on the cover, harrowed, and the cover and manure dug over with mamoties. Ploughing in the cover with manure is very difficult even after harrowing. The cover may be envelope forked along with manure, but this under present conditions would be expensive. Where labour is insufficient for turning in covers by mamoty-digging or the cost of mamoty-digging is prohibitive, the cover may be well harrowed along with manures.

In the course of the experiment mentioned, the growth of the cover crop before turning in produced a sharp decline of yield which reached a peak in the third year. On gravelly soils, particularly in view of prolonged droughts leaving a cover crop untreated for a long time, say over 2 years, cannot be recommended.

Cover crops can also be used as manure by lightly grazing cattle and tethering the animals at night. On hilly lands subject to erosion the treating of cover crops should be done with caution. Further information on cover crops will be found in Leaflet No. 3.

4. MANURING OF YOUNG PALMS.

Recommendations for the manuring of young palms will be found in in Leaflet No. 8.

5. METHODS OF APPLICATION.

No. experiments have been carried out to test the comparative value of different methods of application :—

The following notes are based on common practices :—

(*a*) *Circular Trenches.*—The common method is to apply in circular trenches 3″ wide and 6″ deep cut at a distance of 3′ from the palm.

When manuring is done by tethering cattle (Section 3 (*g*)) it is often the practice to cut the circular trench so that the whole of the soil up to the bole to a depth of 6″ is removed.

On light sandy soils and sandy loams, in order to avoid the cost of cutting the manure circle, particularly during dry weather cattle are tethered without cutting a circular manure trench (usually after sprinkling a few baskets of coir dust when available) and after 7 to 10 days' tethering, spreading the supplementary artificial manure (Section 3 (*g*)), turning the soil along with the manure with mamoties in order to cover up the manure and finally

mulching with a layer of husks or leafy ends of fronds. *This method cannot be recommended for hard gravelly and lateritic soils.*

(*b*) "*Long-Line*" *Trenches.*—In this method manures are applied between the rows of palms in trenches 10′ broad and 6″ to 9″ deep. The advantages of this method is that green manures and husks can be buried at the same time.

Cattle can also be tethered to posts fixed in such trenches.

"Long-line" trenches should not be adopted on estates which have not been manured or cultivated for a long time, where a well-developed root system is not present between the rows.

(*c*) *Broadcasting and Ploughing.*—This can only be recommended on flat lands, where the soils are of an open texture. On sloping lands subject to considerable run-off, this method involves the risk of loss of manures by erosion.

Manures may be obtained mixed. It is often preferable to obtain the individual manures and mix at the time of application. This can be done in the field as follows : The individual manures are weighed or measured out in standardised tins according to the weight per palm into a gunny bag spread on the ground, then mixed by hand and applied direct.

The manures should be uniformly applied, forked into the soil of the manure circle or trench with mamoty forks and covered with soil.

One layer of husks with the convex side facing upwards may be placed in the manure circle and covered with soil or used as a mulch on top after covering. For further details on the utilization of husks see Leaflet No. 5.

6. TIME OF APPLICATION.

Manures should be applied during the South-West and North-East Monsoons, preferably after the heavy showers are over. In districts where the South-West Monsoon is uncertain, such as Puttalam and Batticaloa, it is advisable to manure mostly during the North-East Monsoon.

7. BIENNIAL vs. ANNUAL MANURING.

It sometimes happens that manuring is followed by a drought, and the full effect of the manure not produced. It has been shown that potash manure applied to the soil is converted from an easily available (exchangeable) into a slowly available (non-exchangeable) form, when the soil is subjected to prolonged drying as occurs during droughts. There would, therefore, be a smaller risk if, instead of applying a full dose of manure in full circles or in trenches between every row once in 2 years, half this amount is applied annually in half circles or in alternative rows. In the manuring of orchard crops which like the coconut palms respond to potash, the modern idea is that potash fertilisers should be added frequently in small amounts rather than infrequently in larger amounts.

8. SELECTIVE MANURING.

Just as poor soils show a larger response to manuring compared to good soils, palms in low bearing respond to manures better than heavy bearers. Where circumstances do not permit the manuring of an entire estate or field, selective manuring of backward palms is to be recommended. Even under normal circumstances selective manuring would be judicious. The present practice of giving a uniform dose of manure to all palms seems, unscientific, as well as uneconomic, while no doubt, the application of several mixtures would involve practical difficulties.

9. IMPORTANCE OF ADEQUATE CULTIVATION.

Particular attention should be paid to this Section.

We should not ignore the importance of adequate cultivation involving tillage operations that bring about a physical improvement of the soil, particularly in relation to soil moisture, if the best results of manuring are to be obtained. There seems to be an opinion that cultivation causes root damage, and as such is disadvantages. On the other hand, the coconut root-system is such that in the process of cultivation, numerous feeding rootlets are developed from the damaged root-ends, and this would certainly stimulate the uptake of plant nutrients.

Cultivation operations aimed at the conservation of soil moisture are of the utmost importance. The first line of defence in conserving soil moisture is an adequate system of catch-water drains. The second line of defence is burying husks, particulars about which will be found in Leaflet No. 5.

Ploughing should immediately precede manuring or immediately follow. Where a full dose is applied, the entire area between the palms should be ploughed ; if half dose alternate rows corresponding to the half circle or rows.

10. LIMITATIONS OF SOIL ANALYSES.

Many requests are made for analysis of soil samples of estates for purposes of recommending manure mixtures. There seems to be a considerable amount of popular misunderstanding on the use of soil analysis. No reliable recommendations can be based on soil analysis until data correlating such analytical figures with accurately designed field experiments are available for coconut soils. So far we have some data on the phosphate needs of coconut soils as shown by such analysis, but it has severe limitations when applied to other requirements.

C. R. S. Leaflets on Coconut Manuring.

No. 3. Cover Crops Suitable for Coconut Estates.
,, 5. Utilization of Husks on Coconut Estates.
,, 8. Manuring of Young Palms.
,, 9. Locally Available Materials of Manurial Value.

THE USE OF LIME AND SALT FOR MANURING COCONUT PALMS

BY

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(1) Many inquiries are received by the Soil Chemist's Division of the Coconut Research Scheme regarding the possible beneficial effects of lime and salt (in the form of denetured salt or salt sediment) in coconut manuring. The notes in this leaflet are intended to meet such inquries and to set out the lines on which the Division's recommendations are made.

(2) Though we have no data from controlled experiments, the following information based on the known chemical and physical effects of these constituents on the soil should meet present requirements.

(*a*) *Lime.*—Proposals to use lime are based on the following claims :—

(i.) *Possible effect of " correcting acidity. "*—Coconuts however, tolerate a wide range of soil reaction, extending from extreme alkalinity on coral atolls to extreme acidity on peaty soils without any ill-effect so long as adequate supplies of potash and other manures are available and the soils are drained.

The actual calcium (not *lime*) needs of the palm are relatively small and should be adequately provided by the calcium in such manures as bonemeal, saphos phosphate (calcium phosphate) and calcium cyanamide. If the debris of a coconut estate such as butt-ends and fronds (" branches ") are returned to the soil either by burning during ploughing or manuring or by mulching, calcium taken up from the soil is actually returned in an available form, so that the calcium status of the soil is thereby maintained.

(ii.) *Releasing Available Potash.*—In this connection our observation is that lime broadcast, and ploughed, perhaps due to release of potash, the dominant requirement for coconuts, effects an immediate increase in crop, but this in three or four years is followed by chlorotic appearance, yellowing of the crown, and leaves subject to grey blight (Pestalozzia *palmarum*)—typical signs of potash deficiency and an inevitable decline in yield, probably due to exhaustion of potash reserves in the soil.

Lime without manure makes father rich and son poor, is a popular saying in British farming lore, which may hold good in the case of coconuts too. This is particularly true of light sandy and gravelly soils, though not on heavy clay soils with reserves of potash.

Leaflet No. 13, Coconut Research Scheme, Ceylon.
(This leaflet is supplementary to Leaflet No. 12 :—" Notes on the Manuring of Coconut Palms.")

(iii.) *Improving Texture of Heavy Clay Soils.*—Liming is certainly a well known practice in farm lands to improve the texture of heavy clays in temperate climates. But the minimum rates applied are at least 2 to 3 tons per acre. On coconut estates, the use of such doses are out of the question, costing today Rs. 200 per acre or more, whereas improvement of texture and that of a permanent nature can be more economically realised by cultivation operations such as draining and husk burying. (See Leaflet No. 5, Section 7.)

It is therefore recommended that money spent on liming can be better utilised on other essential manures, particularly on potash.

(*b*) *Lime for Improving Pasture.*—The only case where liming in moderate quantities of 2 to 3 cwts. per acre, broadcast and ploughed and then harrowed (or better ploughed, then limed and harrowed to allow the shallow-rooted grasses to absorb the maximum) can be justified, is when it is used to improve the lime content of pasture where imported breeds of cattle are kept on the land. This can, of course, be better achieved with basic-slag or saphos phosphate which improve both the lime and phosphoric acid contents of pasture.

Addition of lime alone is, therefore, injudicious for this purpose as both lime and phosphoric acid are required for the balanced mineral nutrition, particularly bone formation of such animals, in contrast to the needs of indigenous cattle whose mineral requirements are comparatively small and should be met by the normal content in unlimed and unslagged pastures. In this case biennial applications of 2 to 3 cwts. per acre (or even up to 5 cwts.) can be considered better than infrequent heavy applications, in order to reduce the losses by leaching under conditions of heavy rainfall.

(3) *Salt.*—The alleged reasons for the use of salt are briefly mentioned here, but are based on exaggerated and unscientific deductions. The reasons usually stated in support of the use of salt are :—

(i.) *The palm thrives on the littoral owing to the presence of salt in sea water.* On the other hand palms thrive unmanured in the hinterland as in the Kurunegala district away from the sea, without the addition of salt. It is quite probable that it is the potash in the sea water and not the sodium chloride that benefits coconuts in this case.

(ii.) *The use of salt is alleged to improve the water-holding power of the soil* by the hygroscopic nature of salt and aid the palms in withstanding droughts. As common salt is a material which absorbs moisture, it has been assumed that when added to the soil it remains unchanged and favours the retention of water. When applied, salt enters into chemical reaction with the clay portion of the soil and one cannot imagine how a few pounds per palm of salt can improve the water-holding properties to a material extent.

(iii.) *That Sodium Chloride in salt can replace potash as a plant nutrient.* —For certain potash-loving crops, such as turnips it has been claimed that the use of salt economises the uptake of potash, but we have no such evidence for coconuts.

(iv.) Application of salt may liberate potash by base exchange, but here too continued use of salt can ruin the texture of the soil.

(v.) Salt from the local salterns has been claimed to be beneficial, as it contains small amounts of potash, but our analyses have shown that only traces and that in very variable amounts are present. (See Leaflet No. 9, Section 2 (*g*)).

Until experimental evidence is available we cannot recommend the use of salt as manure for coconuts and *as with lime, money can be better spent on other essential manures whose beneficial effects have been proved beyond doubt.*

REPORT OF THE PROCEEDINGS OF THE ELEVENTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD AT PERADENIYA IN THE ASSEMBLY HALL OF THE SCHOOL OF AGRICULTURE, AT 9 A.M. ON MONDAY, NOVEMBER 18, 1946.

MR. H. W. Amarasuriya, M.S.C., Vice-President of the Board, presided in the absence of Mr. L. J. Seneviratne, Director of Agriculture, and the following were present:—Mr. Chas. A. M. de Silva, Mr. A. R. Panditesekera, Mr. A. T. Sydney Smith, Dr. Reginald Child, Director, Coconut Research Scheme, Mr. S. G. Taylor, Director of Irrigation, Mr. M. Atkinson, Dr. D. E. V. Koch, Acting Chemist, Dr. W. R. C. Paul, Divisional Agricultural Officer, South-Western Division, Col. T. Y. Wright, Mr. S. L. Bandara Dharmakirti, Mr. P. B. Bandaranayake, Mr. S. Sivapalan, Mr. K. Chinnatamby, Mr. R. T. Chelliah, Dissawa A. E. Madawala, Dr. A. W. R. Joachim, Acting Deputy Director of Agriculture, Mr. L. B. de Mel, Gate Mudaliyar M. S. Kariapper, Gate Mudaliyar N. Wickremaratne, Rev. Fr. L. W. Wickremasinghe, Mr. A. R. T. Gibbon, Sir Wilfred de Soysa, Mr. K. Kanagasabai, Mr. Marcus S. Rockwood, Dr. M. F. Chandraratne, Botanist, Mr. C. B. Edwards, Mr. Simon Abeywickrema, M.S.C., Dissawa T. B. Poholiyadda and Mr. M. J. Perera, C.C.S., Secretary.

The following visitors were also present:—Mr. S. K. Thuraisingham, Supervisor, State Farms, and Mr. A. B. Attygalla, Acting Tobacco Officer.

Letters and telegrams regretting inability to attend the meeting were received from the following members:—Director, Tea Research Institute of Ceylon, Commissioner for the Development of Agricultural Marketing, Mudaliyar Abulcassim Marakar, Mr. R. Bois, Chairman, Planters' Association of Ceylon, Conservator of Forests, Mr. Bruce Gibbon, Mr. R. H. de Mel, Mr. Wilmot A. Perera, Sir James P. Obeysekera and Mr. H. Q. M. Jayawardene.

I.—CONFIRMATION OF THE MINUTES OF THE LAST MEETING.

The minutes of the last meeting held on August 12, 1946, copies of which had been circulated among the members, were confirmed subject to a few amendments incorporated by some members.

II.—CHANGES IN THE PERSONNEL OF THE BOARD.

(*a*) The Chairman referred to the death of the late Mr. R. C. Kannangara and of the late Mr. C. N. D. Jonklaas, nominated members of the Board. Referring to the late Mr. Kannangara, the Chairman said that Mr. Kannangara had started life as a Planter many years ago and had taken a great interest in agriculture and was elected a member representing Morawaka in the last election of the State Council. Mr. Kannangara had taken a particular interest in the promotion of agriculture and he was also a member of the Executive Committee of Agriculture and Lands. He added, that by Mr. Kannangara's death the Board of Agriculture had lost a very valuable member and the Country had also lost a very useful member of the State Council.

Referring to the late Mr. Jonklaas the Chairman said that Mr. Jonklaas, as all the members were aware, was a well known lawyer and that he was from a family of lawyers. He had been a member of the Board of Agriculture for a number of years and had not only been interested in law but in the promotion of agriculture. The Chairman regretted the loss of such a valuable member of the Board.

As a mark of respect to the late Mr. R. C. Kannangara and Mr. C. N. D. Jonklaas, a vote of condolence was passed by the Board in the usual manner.

(*b*) The Chairman introduced Mr. Simon Abeywickrema, M.S.C., who had been nominated to the Board of Agriculture in place of the late Mr. R. C. Kannangara.

III.—ITEM 3. ON THE AGENDA—CENTRAL BOARD OF AGRICULTURE SUB-COMMITTEE ON "MECHANISED FARMING"

The Report from the Convenor (copy of which had been reproduced in Appendix B of the agenda) was tabled. The Secretary read out the report which was as follows :—

"MECHANISED FARMING AND HOW SUCH MECHANISATION WILL HELP THE SMALLER PADDY CULTIVATOR.

SIR,

I have the honour to report that the Sub-Committee appointed by the C. B. A., at the 4th Board-Meeting (16.2.45) after two sittings resolved to postpone its sittings until the arrival and trials of smaller, lighter machines, as the big machinery available at the time were not suitable for smaller Paddy Cultivators in the rural areas for the development of his cultivation and as no official information is available about these smaller mechanised machinery as yet, the meetings of the Sub-Committee stand postponed.

I am, Sir,
Your obedient Servant,
(Sgd.) N. WICKREMARATNE,
Convenor."

The Chairman suggested that in view of the above report the Board should await a further report from the Sub Committee. The Board agreed to this suggestion.

Mr. S. L. Bandara Dharmakirti requested the Chairman to find out when those machines could be expected because the Board had waited nearly 6 months.

Gate Mudaliyar N. Wickremaratne felt that in the whole of Western Province, Matara District and some other parts of the Island, those heavy machines could not be used and said that there were light machines which could be used even on vegetable plots.

Mr. A. R. T. Gibbon said that it would be of great interest to all members if the Chairman could give them some current information about the machinery.

The Chairman replied that he understood from the Secretary that the machines had been ordered and that on their arrival they would be tried. He therefore suggested that further development of the matter should be awaited.

The Secretary said that the Department had ordered for 3 or 4 types of Garden Tractors including the Iron Horse. He regretted that the Engineer was not present to give a detailed description of the machinery. He, however, said that only after the trials were carried out, the Department would be in a position to give any information about their adaptability.

IV.—RESOLUTION RE "CLASSIFICATION OF PADDY LANDS", (*vide* page 9 of printed minutes of 6th Board Meeting, August 27, 1945).

The following letter from the Hon'ble the Minister to the Government Agent, Eastern Province, was tabled :—

"My No. AI. 505/40
Your No. I.M. of 19.10.45.

G.A., E.P.

The opinion of the District Agricultural Committee that the Draft Irrigation Ordinance would suffice, without amendments, to effect the classification contemplated in the motion, is correct.

By order of M/A.L.,
(Sgd.) H. W. RANATUNGA,
for S/A.L.

5th July, 1946.

The mover Mr. K. Kanagasabai agreed to withdraw this resolution in view of the opinion of the District Agricultural Committee that the Draft Irrigation Ordinance would suffice, without amendments, to effect the classification contemplated in the motion.

The Board agreed to the mover's withdrawal of the motion.

V.—RESOLUTIONS DEFERRED AT THE LAST BOARD MEETING ON AUGUST 12, 1946.

(1) Dissawa A. E. Madawala formally moved,—

" In the opinion of this Board, all the earth work in small tanks most of which are now in a state of disrepair, should be done at Government expense as the villagers are unable to attend to this work owing to their poverty and other work."

Dissawa A. E. Madawala had sent in the following reasons in support of his resolution :—

" At present the bunds of these tanks are in a state of disrepair and over-grown with jungle. The earth has been badly washed away and the bunds require strengthening very badly. All the repairs that the villagers have done in the past, do now, or perhaps, will do in the future, can best be described as patch work merely to conserve some water which is often if not always insufficient for the cultivation of the fields under the tanks. Owing to the poor conditions of these bunds water overtops the bunds, and every season patch work has to be done and is done to retain a little water. The extents of fields under these tanks are small—from 4 to 15 acres. Because the extents are small the work should not be neglected by Government as even these small extents count in days of food scarcity, like the tiny drops of water which make the mighty ocean. More so, if our aim is to make this country of ours self-sufficient as regards food.

In the present state of these tanks very often when the paddy is maturing the meagre supply of water is exhausted and the crop becomes a failure or of a very poor quality. If the bunds are brought to a good condition the crops could be saved by conserving sufficient water.

The poverty of the villager is proverbial and his pitiful economic condition is common knowledge. Some of them own only insignificant extents of fields and the yield from them is equally insignificant ; for the greater part of his livelihood, therefore, he has to depend on other means like chena cultivation and cooly work. In consequence it is a life-long struggle to him to save himself and his family from starvation. Of necessity he devotes the barest minimum of time required on his field work and employs the remainder on chena cultivation and other work which are of equal importance to him in the peculiar circumstances of his case. He knows that the cultivation of paddy is entirely unremunerative that the yield is poor and that the return from it is not at all commensurate with the labour expended on it. He is, therefore, not inclined to devote any more than the barest minimum of time on field work. In fact, if he did spend on this work more time than this minimum, he did so at the expense of other work which was just as important and necessary, if not more, to him to keep body and soul together as the cultivation of paddy. There are also villagers who own fields under tanks on the working list. In these cases they have to contribute maintenance work which involves a good amount of time, and leaves them much less time to spend on small tanks. It may also be argued that the villagers are inactive and lethargic and do not devote sufficient time on their field and tank work. There is no doubt much substance in this view, but before the poor villager is condemned in this fashion it would seem fair to look into the cause of this state of affairs. The economic condition of the villager, as I said before is simply pitiful. Its direct result is malnutrition

and poor condition of health. Add to these the ravages caused by Malaria every year and you find a villager, sapped of all vitality, resigning himself to helpless fate. Can one expect him to be active and lively in these circumstances ? Things have been allowed to drift and deteriorate into this level and in the unfortunate condition in which the villager now is, it is merely expecting the impossible to happen, if he is left to extricate himself from the mire of long neglect. No doubt Government has done much in the recent past to better the condition of the villager, but there is much more yet to be done and let the restoration of these small and neglected tanks be one such other work calculated to his benefit. Let us not forget the part played by the village farmer in the last few unprecedented years in saving this country from starvation at the gravest hour of its need. Did not this normally unheard of and insignificant man prove himself to be the back-bone of the country ? If so, hasn't the time come for the Government to go to his aid ? Then, why grudge a little work of this nature which is to his benefit in particular and to the benefit of the country in general.

Let Government restore these tanks once and bring them to condition and thereafter tell the villager that it is his sole responsibility to maintain them in the improved condition. I have no doubt that he will come up to expectations.

The meagre extents of paddy lands under these tanks should not be made an excuse for not taking up the work of restoration. As I said before the cumulative result of these little extents is bound to go a long way in achieving our aim, if that aim is to make this country of ours self-sufficient in its requirements of food."

Dissawa A. E. Madawala in moving the resolution desired that all those gentlemen who were present had read the reasons he had given in support of the resolution and hoped that all of them would support him. He made a special reference to those who come from the Dry Zone who, he said, would know the importance of those tanks which are at present in a neglected state. He said that the villager does patch work because he has a lot of other work to do, such as to watch his fields for about 4 or 5 months till the crop is harvested. He also stated that there were no rivers in that area and even if there were, in after about 2 or 3 weeks of the rains they go dry. He concluded—" If our idea is to make this Island self-sufficient every facility should be given to the villager for growing his paddy." He was convinced that he would receive the full support of the house.

Gate Mudaliyar M. S. Kariapper in seconding the motion stated that people were out to get everything free, free education, free hospitals, &c., but what the villagers require were free tanks. He said that wealthy landowners have gone " scot free " for the last ten or twelve years and they had not paid any taxes for the maintenance of those tanks, whereas small landowners were expected to pay for their small tanks. He had observed that some Village Tank Inspectors were appointed to get the earth work done, but the tanks under their supervision too were kept in a bad state of repair.

Mr. K. Kanagasabai expressed his view that before any assistance could be given and before incurring that expenditure prior investigations should be made and the Board should be satisfied whether this village work could not be included in the major works.

Gate Mudaliyar M. S. Kariapper—" It would be like killing the goose that laid the golden egg. "

Mr. Kanagasabai, however, felt that prior investigations were very necessary before that work could be taken in hand because it was not all tanks that needed such assistance and that there were some tanks which could be neglected altogether. He said that by his suggestion it was possible not only to avoid the unnecessary expenditure but also to increase the area to be improved.

Mr. Kanagasabai moved an amendment to the motion, *viz* :—" In all cases where this work cannot be comprehended with a major scheme or when the tank bed cannot be cultivated under the dry farming principle."

There being no seconder, the amendment was lost.

Mr. Marcus Rockwood said that scarcity of water in village tanks had caused great hardship even to cattle and sometimes buffaloes died without water. He emphasised that that itself was enough to warrant the prosecution of the work connected with those small tanks and see that they were maintained with a sufficiency of water for at least cattle to survive because the loss of cattle during the recent drought was very great.

Mr. S. L. Bandara Dharmakirti commenting on this resolution divided village tanks into 3 categories, namely, those tanks that had been in the working list and which Engineers had tried to complete—But he emphasised he did not know when they would be completed if they were left to the mercy of the poor villager—Secondly, little village tanks where maintenance work had to be done. In some cases the maintenance, was very low, but in other cases the maintenance in itself was too heavy for the illiterate villager to tackle—The last category was the insignificant village tanks called "Iswettiyas". He stressed the importance of maintaining village tanks and stated that he had his doubts as to whether the Irrigation Department would favour the acceptance of that resolution because the policy of the Irrigation Department was not to undertake work if the cost exceeded Rs. 60 or Rs. 80 per acre to be benefited. He said that the Irrigation Department thought it was too much to spend on, but they did not realise that " food should not be valued in Rupees and Cents. "

Mr. Dharmakirti moved an amendment—" In the opinion of the Board the earth work in all tanks which are incomplete and which need extensive repairs by way of maintenance work should be done at Government expense. ".

There was no seconder for this amendment and it was lost.

Col. T. Y. Wright sympathising with the motion said he did not see any reason why Government should not repair those small village tanks just in the same way as they had done in the case of large tanks, if they had the labour and the money. He added that in the latter part Government did repair those tanks but it took ages to repair.

Mr. S. Sivapalan spoke in support of the motion and said that it was a useful resolution to be adopted. He, however, wished to know what the Director of Irrigation had to say about the resolution.

Mr. S. G. Taylor, Director of Irrigation, stated that all earth work on village tanks taken up for improvements is done at Government expense now. As it is Government's policy to do earth work, the resolution appeared to him to be redundant. He felt that if the object was to get more village tanks taken up, that policy was in accord with the Minister's policy. He, however, pointed out that having done some earth work, one could not go away and forget about it and expect it to remain in good order. If tanks were to be maintained, regular work should be done. He said that years ago, villagers were expected to do earth work on their village tanks but " Rajakariya " was abolished and deterioration of the village tanks had set in and in 1924 Government found it necessary to create Village Works Sub-Divisions to attend to more urgent cases. He emphasised that wherever that help was given, Government was doing a major share of the work allowing the villager to do the minor part so that the villager would feel he had some share in the work. He was of opinion that the villager having done part of the work would take more care to look after it and do regular maintenance in the future. He stated that in the first place villagers more often than not did not do even the minor part, and secondly very seldom did they do any subsequent maintenance. Later on the policy was changed and Government undertook to do everything—maintenance, masonry, &c., but the villager was expected to do future maintenance. This future maintenance he said was not being done in a majority of cases. He added that that was done on their own responsibility and if villagers

would not help themselves, Government could only touch the fringe of the problem. He also stated that for the past 20 years the Irrigation Department had been engaged on such improvements and admittedly there were thousands more to do, and that Government was doing as much as it could.

Gate Mudaliyar N. Wickremaratne said that the question of whether the villager should do a certain amount of the maintenance work sprang up about the year 1919 and then it was realised how difficult it was for a villager to do that earth work. After that question had been gone through by a Commission it was reported that the Irrigation Department should not be looked upon as a revenue Department and that the payment of taxes was suspended for about 5 years and the new system came into force about the year 1944. He emphatically stated that it was impossible for the villager to attend to earth work and that he saw no reason why if Government could spend millions on major works, some money could not be spent on such minor works.

Mr. S. Sivapalan said that according to Mr. Taylor's statement earth work was unnecessary and that that resolution appeared to him to be redundant. He stressed that it would be interesting to know from the Director of Irrigation what steps had been taken to see that those requirements were carried out by villagers, and that there were certain penalties and what action had been taken to impose those penalties on people who neglected that work.

Mr. S. G. Taylor, Director of Irrigation, saidthat the Department used to have about 20 Irrigation sub-Inspectors who were supposed to be looking after village works maintenance who could not deal with the vastness of the problem, and that it had been decided by Government to appoint about 100 Cultivation Officers who were in the process of being appointed. He said that there were already 40 men appointed and more are being recruited. He added that as soon as those men were trained their object would to be go round village tanks and see that villagers do their job.

Mr. C. A. M. de Silva said that there were certain areas which had not been visited by the Government Agents for the last twenty years and that in some of those areas even paddy cultivation was neglected. He felt that the Irrigation Department should concentrate more on the neglected paddy lands and see that they were put into use.

Mr. Marcus Rockwood stated that the picture drawn by Mr. Taylor was a picture of the past when a measure of paddy was selling for 8 and 10 cents. He said now it was very unlikely that the villager would not maintain his tanks in good repair with the present high price for paddy.

At this stage the Chairman felt that that matter had been discussed sufficiently and that it must be put to the house. He said that although as pointed out by the Director of Irrigation that motion was redundant in view of the present policy, he would commend its acceptance for the Minister of Agriculture and Lands to press the matter further and bring about the necessary amendment of the Ordinance.

The motion was put to the house and carried unanimously.

Taking item 5 (2) in the agenda, Dissawa A. E. Madawala formally moved :—

(2) " In the opinion of this Board the income derived from the paddy lands should be exempted from Income Tax as the cultivation of paddy is not remunerative according to the methods adopted in Ceylon and as an encouragement towards the furtherance of the industry."

Dissawa A. E. Madawala had sent in the following reasons in support of his resolution :—

" Today we are faced with great difficulties owing to the shortage of rice. Our paddy industry should therefore be encouraged at every turn and every help towards its progress should be afforded by Government. Most of the paddy lands are situated in the North-Central, Eastern, Southern and North-Western Provinces. The average yield of

paddy from an acre in the North-Western Province is 6 to 10 fold in the Maha Season. In the Yala it is even less as short-aged paddy is sown and the return from this paddy is less than that from the long-term varieties. If a man gets only 6-fold he will have only 18 bushels from an acre and according to the present price it will work out at Rs. 108 for 5 months, taking medium-aged, paddy into consideration. If he gets 10-fold he will have 30 bushels valued at Rs. 180 also for 5 months. When the cost of working, watching, threshing, &c., is taken into account it will be seen that the result is entirely unremunerative.

At present a large majority of the paddy producers are non-Income Tax payers. But sooner or later most of them are likely to come into the list of payers. We should not be concerned whether the paddy is produced by the rich Income Tax payer or the poor non-Income Tax payer. What we want is paddy to make this country self-sufficient as regards its food supplies, and every encouragement and help should be afforded to the producers. In normal times it was the poor cultivator at whose instance the fields of the rich were cultivated. The rich owner took no interest in paddy cultivation as he had the cheap white rice to eat. With the shortage of rice he has now been forced to interest himself in this industry. As soon as normal times return this interest is certain to flag again. He will think that his Income Tax bill is made unnecessarily even though slightly heavier by doing an unremunerative job. But if the income from the paddy is exempted from the tax, it is possible that his interest in this cultivation may be sustained even to some degree. As this industry even at the present price paid by Government is admittedly unremunerative and as an encouragement towards more extensive as well as intensive cultivation of paddy, the income from this source should be exempted from Income Tax."

Speaking in support of his resolution Dissawa Madawala emphasised that whether it be the rich land owner or the poor villager, what is wanted is paddy for the consumption of the people of this country. He, however, felt that if paddy were exempt from income tax the rich landowner would take a greater interest in the paddy cultivation, " even after the hard times pass away."

Gate Mudaliyar M. S. Kariapper said he had pleasure in seconding that motion and stressed that money invested in National Savings was free from Income Tax whereas paddy was not, although it is more important. He felt that there was hardly any income from paddy, comparing the present cost of production. He hoped that the House would agree with the mover that exemption of Income Tax was an encouragement to cultivators.

Col. T. Y. Wright said he did not think many people now engaged in paddy cultivation paid Income Tax. He felt that if the richer folks should take a greater interest in this product than they did and derived a greater income, they should certainly pay income tax.

Mr. A. R. T. Gibbon said that he was in entire agreement with Col. Wright and felt that it would be most dangerous to create such a precedent because rice producers would become a privileged class. He observed that if that concession was allowed to paddy cultivators similar concessions would have to be given to cocoa growers, rubber growers and coconut growers and therefore he was not in favour of that motion.

Mr. C. A. M. de Silva too did not agree with that resolution because, he felt that it was the rich landowner, who exploited the poor cultivator, who would be benefited by that resolution. Therefore he opposed it.

Mr. A. T. Sydney Smith entirely opposed the principle underlying that resolution. He said if encouragement for paddy cultivation was necessary it could be given in the way of a subsidy instead of helping them to evade income tax which would create a most undesirable principle.

The Chairman said that the principle underlying that resolution would defeat the very object the Dissawa had in view. He said that the Government did give them subsidies by way

of free distribution of manure, pure line seed paddy, and by waiving irrigation rates for many years. He observed that exclusion of paddy from income tax would be tantamount to class discrimination—discrimination between one class of producer and the other—.

Gate Mudaliyar N. Wickremaratne requested the mover to withdraw that motion because it required more consideration and the Board agreed with that view.

At this stage Dissawa Madawala said that in his opinion he thought that that was one of the ways how paddy cultivation in this Island could be extended and that he had observed from the speeches made that most of the members were not in favour of that resolution and he would withdraw his resolution as suggested by Mudaliyar Wicrkemaratne. He, however, hoped to gather more facts and re-introduce that resolution again.

(3) Gate Mudaliyar M. S. Kariapper formally moved,—

"That this Board is of opinion that a 'Central Tobacco Committee' should be immediately set up, charged with the duty of aiding the improvement and development of the cultivation, production and marketing of tobacco products."

Gate Mudaliyar M. S. Kariapper had sent in the following arguments in support of his resolution :—

"1. The War is over. In consequence, Lanka's wartime boom is ebbing away. We are on the perilous edge of a period of more or less inaction, which will drive us into a bitter economic depression leading to low price of agricultural produce and growing unemployment among our people. It is one thing to talk of doing something when there is plenty of time between the word and the act. That is why we had so much talk of a new Lanka in recent times. But the sudden cessation of hostilities has found us still in the talking stage. We need not be desperate about the future if we would transfer forthwith all the talk to action.

2. The most important item in any post-war programme of economic activity is the re-habilitation of agriculture. This fact is beyond question. And in the domain of agriculture, a money-crop of major importance that has so far been neglected or followed on a small scale, is the cultivation of tobacco. And the scientific and methodical cultivation of tobacco on a commercial scale represents a potential source of income.

3. At present, a few hundreds of acres in isolated tracts are under tobacco in Ceylon. The species cultivated on most of our lands is not of a remunerative type. Nor is it able to command a world market, to which neither the quality of the leaf nor the method of curing it appeals. In consequence, the tobacco grower is invariably affected by the vagaries of the Jaffna and Malayalam markets which are his sole buyers. During this current season, the price of the tobacco leaf went so distressfully low that the mover of this resolution and his fellow tobacco-growers made desperate and urgent appeals to the Director of Agriculture and the Marketing Commissioner for assistance in the dispersal of the produce at reasonable prices. Our appeals were fruitless. Not that they were not willing to help us but that they were powerless, as the cigar-tobacco plant grower and the process of cure adopted, could command only a limited local market. It is here that the 'Central Tobacco Committee' could have come in with great profit to us, with the necessary advice and assistance, to guide us in the correct path, having regard to the changing tastes and conditions of the market. We also experience considerable financial loss and depreciation of tobacco leaf, "rating" as the result of our ignorance of scientific methods of annihilation of insect pests such as the Tobacco Stem Borer. This Committee can help us in tackling this problem as well with maximum success.

4. Apart from the reasons above set forth, please remember that Rs. 3,000 is being spent every hour in Ceylon on Tobacco. Please remember that the Ceylon Customs' Return reveals the fact that tobacco and tobacco products of an average value of over

Rs. 2,000,000 are being imported to this country every year. Can this little Island of ours stand this very heavy drain on its financial resources ? I say that Ceylon can produce tobacco, if cultivated on the proper line, to meet the entire demand for local consumption and also have surplus for export to other countries. Our climate, our equable temperature and the fertility of our soil are factors that assure me and re-assure me that I am not mistaken in my opinion.

5. The needed impetus must come from Government. The Ceylon Government should establish a ' Central Tobacco Committee ' for this purpose. I understand from an article in the " Ceylon Industrial and Trade Recorder " from which I have taken the liberty to draw some of my arguments that the Government of India realizing the importance of tobacco as a commercial crop has decided to set up a Central Tobacco Committee. The Ceylon Government will do well to copy India's example. Indeed, the condition of the agrarian workers demand it, if the incidence of indebtedness among them is to be avoided. Let us start now and at once to make tobacco cultivation another major agricultural industry of Ceylon, if Mother Lanks is to stop bleeding to the tune of two million rupees every year in order to meet her tobacco bill."

He said that he had put forward all the arguments he urged in support of that resolution and hoped that the Board would agree with him that Tobacco is a money crop and as 99 per cent. of the men in Ceylon are smokers and as the expenditure on tobacco in this country is about Rs. 3,000 per hour the Tobacco Industry in Ceylon should be encouraged. He therefore submitted that motion for the favourable consideration of the house.

Mr. R. T. Chelliah in seconding the motion felt that if the committee were formed much work could be done to improve the Tobacco Industry in Ceylon.

The Chairman called upon Mr. A. B. Attygalla, Acting Tobacco Officer of the Department to give some information about the tobacco trials. Mr. Attygalla said that three brands of light cigars to meet Ceylon conditions have been produced by locally grown tobacco. He said that trials were being carried out in various parts of the country with types of cigarette tobacco. He stated that the trials so far had been successful and that the cigars he had distributed among those present at the meeting had been from the first trials carried out and that the cigars were turned out by a local firm. He felt that the formation of a Committee would assist them to find out even foreign markets in that product. The cigars distributed by Mr. Attygalle were 3 brands manufactured from tobacco grown at Wariyapola of the Burmese and American varieties.

Mr. C. A. M. de Silva commented that experiments had been carried out for a long time and wished to know how successful the effort had been to produce a cigar to replace the imported cigars.

Mr. A. B. Attygalle replied that the existing tobacco trials were carried out from 1939 and that from the beginning most of their time was devoted to evolving suitable types of cigarette tobacco. He added that that was the first experiment in cigar tobacco and he assured that fair success had been gained.

This resolution was put to the house and carried unanimously.

(4) Mudaliyar Abulcassim Marakar to move,—

" This Board is of opinion that immediate steps be taken for the restoration of the Vavunikulam Tank in the District of Mannar."

Mudaliyar Abulcassim Marakar had sent in the following arguments in support :—

" (*a*) *History of the Tank.*—The traditions regarding this tank are that it is the largest in Ceylon and that its chief channel lead as far as Tunnukai village. The tank is vested with a peculiar historical importance in that it is clearly linked with an Irrigation Work, which is accepted as the first largest reservoir built in the Island solely for the storage of water for irrigation purposes.

There are many vestiges scattered over the area to testify to the agricultural felicity that prevailed under the Sinhalese Dynasties.

The construction of the tank dates as far back as the third century.

(*b*) *Benefits derived*—by the restoration of the tank. This tank will be able to irrigate an extent of more than 8,000 acres of land. The land is fit for paddy cultivation, tobacco and for other food crops. There is good water in the area. Timber is available for building houses. There is adequate pasture ground for cattle. The land under this tank is eminently suited for colonisation purposes and for food production. Food production after the war is not a temporary measure although local food production had made some contributions in tiding over the crisis of the last few years to meet an emergency.

Ceylon should continue the food production campaign more vigorously as a permanent feature of her economy.

It would not be wise to base any expectations upon the rice crop from Burma as a solution to the food shortage in Ceylon. Government should explore all the possible avenues to encourage her food production permanently.

The restoration of the tank will contribute in no small measure towards the achievement of the object of making Ceylon self supporting."

The Chairman read out a letter from the mover withdrawing his resolution in view of the assurance given by the Minister to have this tank restored.

(5) Gate Mudaliyar N. Wickremaratne formally moved,—

"That the Department of Agriculture be requested to take necessary steps to establish a suitable organisation of weather service for the cultivator."

Gate Mudaliyar Wickremaratne had sent in the following arguments in support :—

"In my leaflet 'The Aim of the Paddy Growers Association' for Ceylon, I stated that 'The climate and weather conditions form a great factor in the cultivation of paddy. The weather conditions are responsible for accounting of 50 per cent. of the possible yield in paddy. This loss is unknown. The cultivator was a weather prophet in days gone by but now things are changing for the worse. Therefore two things are needed. Those officials who deal with this subject of paddy cultivation should have a good knowledge of the local weather and climatic conditions and work to save this loss. Secondly, a properly devised weather service should be established by the agricultural and meteorological authorities to warn the cultivator of the impending variation of weather." Since then we have experienced a serious change of weather conditions all over the Island with great loss to the cultivators and greater loss to the cause of food production in the Island. I have visited several parts of the Island during the last 2 or 3 months and I feel grieved to see the complaisant manner with which these authorities have taken up this loss as an inevitable thing. I say that it is an important matter if the Agricultural officers have been acquainted with weather conditions 'they could have saved this loss to a great extent and have helped the food production.' There can be no doubt that the cultivator will benefit greatly if he knows beforehand what the weather is going to be like. For instance if he is told when the monsoon season is likely to start and later, how the rainfall may vary from day to day during the season, when the risks are expected and when there will be a resumption of wet weather, he would be able to time the various important cultural operations in the most advantageous manner and with a minimum of risk to the crop. We have a Department of Agriculture and there is a well equipped meteorological observatory in

Colombo and what is wanted is to get agricultural officers to be acquainted with the work of the latter department and make use of the knowledge of the meteorological officers and then forecasts carried to the cultivator in a way that such forecasts are helpful to him in deciding what and when to grow his crops. The agricultural officer on the other hand should be in a position to acquaint the meteorological officers with the kind of crops grown and the periods they take for harvesting and so on. The coalition of these two officers will render a service to the village cultivator as well as the agriculturists in general."

Gate Mudaliyar Wickremaratne said that during the last 5 years people have found a constant change of weather conditions and therefore some connection between the Ceylon Observatory and the Department of Agriculture was necessary to forecast weather conditions for the information of the cultivator. He said that the very fact that there are two seasons called the Yala and Maha could not be depended upon due to constant changes in the weather. He emphasised that villagers either abandon their cultivation due to lack of rain or they suffered from unseasonal cultivation. During one of his recent visits to Allahabad, he had learnt that the Department of Agriculture, Allahabad was going to appoint a trained officer to forecast the weather for the benefit of cultivators. He added that in the olden days many of the cultivators used to read the " Panchanga Litha " which was a source of information about the weather, but now the changes were so frequent that they could no longer be guided by the " Panchanga Litha." Referring to the rainfall recorded at different stations in the Island, Mudaliyar Wickremaratne said that in the past a good number of planting districts had taken a great interest in the recording of rainfall figures which is now gradually dwindling down, and that sufficient interest should be taken to increase the number of rain-gauge stations too.

Gate Mudaliyar M. S. Kariapper in seconding the motion complimented the mover for his brilliant idea. He said that in days gone by there was the " Panchanga " to guide the people but today even the " Panchanga " has gone wrong " with the introduction of the atomic age."

Col. T. Y. Wright said that from his experience he had observed that village cultivators were very good at forecasting the weather.

Gate Mudaliyar N. Wickremaratne humourously added—" The Observatory makes predictions after the event."

Dr. A. W. R. Joachim, Acting Deputy Director of Agriculture said that the supply of meteorological information was the responsibility of the Ceylon Observatory. It was an organisation fully qualified for this purpose, unlike in the case of the Department of Agriculture. He, therefore, suggested that the Observatory should be asked if they were prepared to co-operate in offering facilities to this Department for obtaining the information required by Mudaliyar Wickremaratne.

Mr. Marcus Rockwood drew the attention of the Board to a suggestion he had made at the beginning of the war that if there was co-ordination between the Observatory and the R.A.F. Stations, the purpose suggested in the resolution could be achieved as the R.A.F. had frequent reports of the weather over a wide range of the country.

This motion was put to the house and carried.

(6) Gate Mudaliyar N. Wickremaratne, next moved,—

" This Board is of opinion that better facilities for the distribution and marketing of vegetables will not only give a better remuneration to the grower but also help to increase the production and therefore the Board request the authorities concerned to organise effective co-operative or other organisations to give effect to proper distribution and marketing of vegetables."

Gate Mudaliyar Wickremaratne had sent the following arguments in support :—

" During the past few years those of us who were about the country have seen the ill effects of the existing methods of the distribution and marketing of vegetables in the country. In nearly ninety-nine out of a hundred cases the grower does not get the price he deserves for his efforts to grow vegetables and the consumer pays a hundred per cent. more than the actual price of the commodity.

Again the congestion of certain commodities in certain localities and the scarcity of the same commodity in other localities were noticeable in every part of the country. While a lime fruit is sold in Colombo at 10 cents a fruit, I came across places where limes were sold at Rs. 1·50 a hundred. Recently while 100 limes were sold in Kandy market at 65 cents, these were sold in Colombo at 3 or 4 cents a fruit. This is only one instance where facilities are given to proper distribution.

In these cases the grower has no chance of getting what he should get and the consumer pays to enrich a middle-man who is unduly benefited as a result of the existing method of distribution and marketing as for want of no method. What we want are proper marketing surveys, and proper organisations to deal with the grower and the standardization and stabilization should follow.

I commend this proposal and request the Board to urge the authorities to give a fair deal to the vegetable grower for his property and to make him to grow sufficient produce for the use of the consumer."

The Chairman said that he had received a communication from Mr. Bassett, the Commissioner for Development of Agricultural Marketing, stating that he was unable to be present due to ill-health and requesting a postponement of the motion.

Mudaliyar Wickremaratne said that that was the 3rd time that motion was going to be postponed. He remarked that once it had to be postponed because Mr. Bassett was away in Africa and a second time too it had to be postponed as he was not present, but he said that even this time he would not proceed with the resolution because he wanted Mr. Bassett to be present when that motion was to be discussed. He said that there was another gentleman from Welimada who should also be present when that subject was to be discussed, and as he was also absent he would agree to the postponement of that motion for the next meeting.

(7) Mr. A. R. Panditesekera suggested with reference to the motion in his name that the words " generally and particularly " be added to read—" Steps should be taken to increase the production of coconuts generally and particularly of small holdings in the Island in the immediate future." The house agreed to this addition and Mr. Panditesekera formally moved,—

" That in view of the alarming decrease in the production of coconuts, which is the main money crop of not less than 90 per cent. of the residents of both Chilaw and Puttalam Districts, this Board is of opinion that steps should be taken to increase the production of coconuts generally and particularly of small holdings in the Island in the immediate future."

He also wished to make an amendment in the reasons he had given in support of that motion, *i.e.*, to substitute the words " once in two years " in place of the words " in two annual instalments."

Mr. Pandittasekera had sent in the following reasons in support of his resolution :—

" Coconut production has in 1939 come to almost the same level as in 1923, although many more acres have been brought under coconuts since 1923. The causes may be attributed to the following :—

(1) Want of manuring and soil cultivation.
(2) Senility of some plantations.
(3) Weather conditions.

I would suggest that the Government find ways and means of supplying manure at cost price to small holdings of 25 acres and less, once in two years, the cost to be recovered in instalments from the fourth year. Demonstration plots in coconut growing areas should be established where latest scientific methods of soil cultivation, manuring and replanting should be demonstrated.

These stations may be in charge of an experienced officer (experienced planter preferred) who should form committees of intelligent residents in the villages where these stations are established. The officer in charge should instruct the committee on the latest methods of soil cultivation, manuring and replanting, who, in their turn should visit those who propose to cultivate the soil, manure or replant and advise them as to how best this could be done.

This officer may when convenient visit these plantations and himself advise the owners and also hold meetings of those interested where advice may be given on matters concerning latest methods of planting coconuts and increasing its production. Selected seedlings should also be supplied at cost price to those willing to under-plant or fill vacancies.

I need not take the time of the Board to allow that soil cultivation helps to overcome short rainfall. Some may think such help as I have suggested does not now arise as we are having a good market. Though a good price is realised for coconut produce, the shortage of nuts, high cost of living and high labour wages leave us just where we were during the slump especially in the case of small holdings."

Mr. Panditesekera said that there are about one million acres of coconut under cultivation out of which nearly 75 per cent. is owned by small holders. He said he was only urging that the small holder be put on his feet. He suggested that manure should be supplied to the whole industry at cost and that Government should recover that expenditure by means of a cess. He emphasised that the industry had gone through a very hard time and that 90 per cent. of the cultivators had given up cultivation and manuring. The only type of manuring which was possible by the cultivators was to bury waste matter, refuse, &c., round the trees, because imported manures were very expensive. He also compared the figures for the production of copra during the years 1923, 1925 and 1943 which revealed that there was a remarkable drop in production and he agreed with the remark made by Sir Oliver Goonetilleke in this connection that the Coconut Industry was dying.

Mr. Marcus Rockwood in seconding the motion said, that he had pleasure in supporting that motion and was of opinion that in taking the figures collected by Mr. Panditesekera, factors such as the drought that had killed thousands of trees in the North-Western Province should be taken into consideration. He believed that " there was something in the air " by way of a tax. His idea was that a tax should be held in reserve for the coconut production, which could be utilised for replanting and cultivation.

Mr. C. A. M. de Silva apologised for holding a different view from other coconut growers, for, he said the real shortfall in production was in his opinion due to bad management. He paid a tribute to the Coconut Research Scheme for having given sufficient data with regard to manuring, but he stressed the difficulty of getting manure although Mr. Rockwood had said that " there was something in the air " for them. He said he could not commit himself at that meeting by expressing exactly what is in store for coconut cultivators, but he could safely state that the Registrar of Co-operative Societies was planning for a scheme to give the coconut industry manure on co-operative lines. He also emphasised that the villagers' idea is to wait till the manure comes to their very door. He believed that there was some truth in the statement that once when artificial manure was applied it had to be applied throughout. The drop in copra he said was due to quite a large number of reasons and above all he observed that a larger number of coconuts were consumed in the Island today, because the present food

require a larger number of coconuts being consumed, and in some cases young coconuts were consumed to replace food. In support of this statement he cited the pingo-man carrying loads of young coconut as an example. Commenting on the drop in production he said he was however not going to attribute that loss to be a colossal loss merely judging from the export figures. He observed that this was the best time " to put the house in order " with a high price for coconuts. Commenting on the experience the Country had gained in distributing manure, he said, it was the tax payers' money and presumed that the tax payer would not like to see one industry being supported by another. He suggested to the mover of that resolution to consent to a Sub-Committee being appointed to evolve a scheme by which all growers of coconuts could be supported.

The Chairman said that it might be expedient to delete the words, " That in view of the alarming decrease in the production of coconuts, which is the main money crop of not less than 90 per cent. of the residents of both Chilaw and Puttalam Districts."

Mr. Panditasekera the mover of the resolution agreed to the deletion of the words suggested by the Chairman.

Dr. R. Child, Director of the Coconut Research Scheme said that since 1939 the Scheme had been drawing attention to the declining coconut production. He was glad that the drought of the last year or two had driven it home at last. He stated that Mr. de Silva had done very well in calling attention to the fact that most people based their estimates on export figures only. It was not very well, though, to be despairing about the situation and exaggerate it. It was commonplace among people who had anything to do with coconut that the drought that had been experienced for two years running, might easily have caused a 25 per cent. drop in production or probably more, while not only production, but exports had also dropped and consumption in Ceylon had decreased. He, however, remarked that the position was serious enough to warrant consideration. He admitted that as far as the Coconut Research Scheme was concerned, relatively little attention had been paid to small holders. The Board had on occasions during the past few years discussed the appointment of a Small Holdings Officer, but did not come to any conclusion how such an Officer's duties could be organised. He added that in a recent memo. the Board with the advice of Technical Officers had come to a conclusion which corresponded very closely to what Mr. Panditesekera suggested—*i.e.*, the establishment of Demonstration Centres with an Officer to look after them—He said that those were proposals of the Board, which were submitted to the Executive Committee of Agriculture and Lands. He was of opinion that a number of Demonstration Centres should be opened up and that those centres should preferably be in proximity to existing cultivation. The Board had also recommended in 1924 a Travelling Officer to visit coconut estates and advise Superintendents. He felt that it was a bad system for a Research Officer to be travelling. Taking up the question of re-planting, he said that replanting should go side by side with manuring. In his opinion the small holder was not so backward as the estate owner and his impression was that the small holder was more alive to replanting. The Coconut Research Scheme had done its very best with its very limited resources and he was glad to record that the Department of Agriculture is closely associated with them in replanting. The Department had proposed to establish centres to provide coconut seedlings and plants where seed nuts would be provided by the Coconut Research Scheme. He said that in regard to finance, a suggestion had been made by the Commissioner, Commodity Purchase, that a certain amount should be reserved and revoted for the development of the industry and even to organise a large replanting scheme. He felt that that suggestion was commendable. Dr. Child agreed with the view that Co-operative Societies could help in the way of collecting the produce from small-holders and distributing fertilizers.

This motion was put to the House and carried.

The following Sub-Committee was appointed to report on what steps should be recommended to improve the Coconut Industry :—

Mr. A. R. Panditteseker a,
Mr. Marcus Rockwood,
Dr. R. Child (Convenor),
Mr. C. A. M. de Silva,
Mr. R. T. Chelliah,
Sir Wilfred de Soysa,
Col. T. Y. Wright, and
Gate Mudaliyar N. Wickremaratne.

VI.—FRESH RESOLUTIONS :—

(i.) Mr. K. Kanagasabai formally moved,—

"That this Board advises the Ministry of Agriculture and Lands to afford the necessary facilities for raising other crops in rotation with paddy, with a view to—

(*a*) Multiply the production of other cereals besides paddy.
(*b*) Conserve the fertility of the soil by growing leguminous crops on the lands under the plough.
(*c*) Aid and encourage the cultivation of cotton on irrigable lands to meet the requirements of yarn for making cloth.
(*d*) Provide continuity of service on the lands for the cultivators, and finally
(*e*) Increase the economic benefits of the farmers."

Mr. Kanagasabai had sent the following reasons in support of his resolutions :—

(i.) Control and management of paddy cultivation were transferred from the Irrigation Department to the Government Agent avowedly with the object of flourishing the industry. But the actual grievances of the cultivators in regard to the flooding and shifting of water supply at the proper periods and to the lack of proper fencing and watching of the cultivated tracts have not yet been remedied. According to the present Irrigation Ordinance the duty of water distribution and supervision of paddy cultivation devolve on what are known as Irrigation Headmen, who can hardly be expected to know even the capacity of the channels and I have often noticed water overflowing on either sides of the channel. So long as this pratice continues it is bound to prove inimical to the interests of the paddy growers.

(ii.) To secure favourable return from paddy cultivation, not only intensive farming is necessary but also full time officers with the necessary technical knowledge should be placed and that the cultivated tracts should be provided with permanent fencing. Absence of necessary legislation and lack of funds are no doubt serious set-backs in this matter.

(iii.) There is also ample work for the officers of the Department of Agriculture to find the means for not allowing the paddy lands to remain always as paddy lands and to put forward schemes in collaboration with the engineering staff of the Irrigation Department to conserve water-supply for the development of all the resources available in the Island and thus make the Country self-sufficient in the matter of the staple article of diet as well as in the production of cotton yarn for raiment."

He emphasised the need for increasing the food supplies in this country. It was most surprising to find that the yield from paddy per acre in Ceylon is 15 bushels whereas in India it is 30 bushels. In Ceylon only about 900,000 acres have been under paddy production which is just enough for 2 million people. It was very important that some effective measures should be taken to improve the food supplies of this country. The poor yield of paddy in Ceylon was

largely due to the poor quality of the soil and climatic conditions. He felt that the yield could be much improved if the rotation of other crops with paddy was adopted. He emphasised that it was very essential to bring all cultivated paddy lands under permanent fencing. He also hoped that the Minister might consider that matter further and provide the necessary legislation to give financial aid to landowners for the purpose. He desired that organisations like the State Mortgage Bank or Co-operative Credit Societies should be opened up to facilitate such cultivators.

This motion was seconded by Mr. S. Sivapalan.

Dr. A. W. R. Joachim, Acting Deputy Director of Agriculture said that from the soil fertility point of view, the Department had been for a number of years carrying out trials to determine which crops could be adequately rotated with paddy. He stated that it was not every paddy area that was suited for rotation of crops and observed that good drainage was a fundamental point for successful crop rotation. Chillies, tobacco, vegetables, &c., could be grown in rotation with paddy, but unless heavy manuring was done the yields were poor. So far as the Irrigation Department was concerned, they were anxious that crop rotation should be introduced in the Yala season as there was insufficient water under several schemes for the cultivation of paddy during this season. He also added that the Department was in certain areas concentrating on the introduction of tobacco during the Yala season.

Dr. W. R. C. Paul said that in the Dry zone there were a number of difficulties in growing two crops in the year. He also said that they were trying to grow green-manure crops during the Yala which would increase the yield of paddy during the Maha season. He had observed that a certain green manure crop like pila had produced very good results in the Maha. He added that there were other legumes which could be grown and which could be used as food.

Sir Wilfred de Soysa inquired whether it was not possible to get any information from India regarding suitable crops for rotation with paddy.

Dr. Paul replied that conditions in India were different to those of this Island. He said that some general information could be got, but the type of crop that would grow there would not grow in this country. He said that so far they have been very successful in the rotation of crops with paddy.

Mudaliyar Wickremaratne said that pila was grown to increase the green manure but it was not intended to increase the food supply. He stated that in Matale there is a track of paddy fields where vegetables were grown in rotation with paddy which brought a good income and a better yield in paddy, too. But he had noticed those fields gradually becoming drier and his belief was that ultimately those fields would become unsuitable for paddy.

This motion was put to the house and carried unanimously.

(ii.) Mr. R. T. Chelliah formally moved,—

"That it is of extreme importance to establish a 'Central Board of Irrigation' on the same principle and style as of the 'Central Board of Agriculture' for the purpose of promoting the system of irrigation in the various parts of this Island and make self-supporting in producing her own food."

Mr. R. T. Chelliah had sent in the following arguments in support of his resolution :—

It is an undoubted fact that the Central Board of Agriculture has made various progress in promoting the agriculture of this country by their constant contact with the Director of Agriculture and the officers of the various Heads of the Government Agricultural Departments. It is very fortunate that once in three months we members of this Board representing the various Provinces and districts of this Island come here and meet together and discuss freely the needs of our Island and have done lot of constructive works. Though many of our suggestions are not fully carried out yet we are sure they are under consideration

in the hands of both the Hon. Minister and Director of Agriculture. It is very unfortunate such an association is not established in an equally important Department like the Agriculture, the Irrigation Department which is unfortunately very very backward in its progress. If a " Central Board of Irrigation " is established it too would have advanced equally well like the Agricultural Department and more lands would have been under irrigation today. I believe mostly all of you are aware of the extent of lands cleared by the Department of Agriculture and you won't be surprised if I tell you that many of these lands are unable to produce enough food as they are not yet irrigable because the Department of Irrigation have not constructed channels for many of these lands. Along with this. many lands cleared by private people are also lying waste for want of irrigation facilities. If the Heads of the Irrigation Department and the public could meet once in a way and discuss their needs, lot of useful works would have been done by the Irrigation Department. It is always good to have a good number of intelligent body to work together than depending in one personal management. The living example is the progress of the Agricultural Department."

He felt that it was very fortunate that the Director of Irrigation was present for this discussion. Mr. Chelliah then read out certain information relating to the resolution. He emphasised that it was a disgrace to Ceylon to depend on a half measure rice from abroad, which if denied, the people would have to starve. He compared Ceylon's prosperity in her food resources during the times of the Sinhalese Kings when Ceylon was even exporting rice. He felt that the system of cultivation adopted by the people of that time were better and even tanks, &c., were maintained in very good order although they did not possess any technical qualifications. Ceylon was sending men to Australia, England, &c., on scholarship at great expense to Government. He stated, it was very fortunate to have got a very farsighted Minister and complimented the Minister's scheme of giving lands to cultivators. But he said it was very unfortunate that complaints have been received from people who had cleared the land, that it could not be cultivated for want of irrigation water.

Gate Mudaliyar M. S. Kariapper seconded the motion and drew the attention of the Board to the Ordinance of 1936 according to which there is provision made for the appointment of an Advisory Committee for every irrigable area.

Mr. S. G. Taylor, Director of Irrigation, commenting on the resolution said that as far as advisory bodies were concerned there were District Agricultural Committees, Irrigation Committees and the Central Board of Agriculture and felt that a Central Board of Irrigation was not necessary. He felt that there was too much talking already in the country. He emphasised that some of the things passed in the Central Board of Agriculture were absolutely impossible to implement. He said that there was a Central Board of Agriculture which deals with all subjects of Agriculture and lands and others, and he saw no necessity for another board. He stressed the importance of having an intelligent body with scientific knowledge if such a Board were to be formed.

Mr. K. Kanagasabai said that it should be realised that they were a body of farmers and were not competent enough to direct the Irrigation Department because their knowledge was not sufficient, and he feared that if such a Board as contemplated were formed, consisting of incompetent men, the whole scheme was liable to collapse.

The Chairman at this stage drew the attention of the house to the functions of the Board which he read out and remarked that the Board could co-ordinate as much as possible but the major co-ordination should be done by the Minister and he therefore felt that they should not try to duplicate the work of the Board. The Chairman felt that there was no need for another body, and as all members had heard the views of both sides of that question he should request Mr. Chelliah to, at least, reconsider that motion.

Mudaliyar Wickremaratne agreed that that matter deserved further consideration of the mover but yet he did not like the way in which the Director of Irrigation replied. Mudaliyar Wickremaratne emphasised that the Director of Irrigation seemed to have changed his policy because almost every resolution brought up to restore village tanks, &c., had met with his disapproval and opposition.

The Chairman, however, said that the Director of Irrigation had not been provocative but he had only acted in an advisory manner.

Mr. R. T. Chelliah very vehemently criticised the policy adopted by the Director of Irrigation and said that the Director of Irrigation had not taken any trouble to visit those village tanks which were neglected and where the poor villagers were suffering. He cited Wannikulam as an example. Mr Chelliah emphasised—" We as Ceylonese should have a right to discuss matters concerning our Country . . . . We are the tax payers and we have every right to make proposals for the benefit of the people."

At this stage Gate Mudaliyar Kariapper requested the postponement of the motion.

The house did not agree to this suggestion.

The motion was put to the house and was defeated by a majority of 8 votes.

(iii.) The next item on the agenda was a resolution to be moved by Mr. H. Q. M. Jayawardene, for the formation of Agricultural Guilds, viz :—

" That the Agricultural Department through the propaganda section should sponsor the formation of Agricultural Guilds to coincide as far as possible, with a D. R. O's Division as Parliamentary electorate."

Mr. H. Q. M. Jayawardene had sent in the following reasons in support :—

" I have in mind an Association similar to a limited liability company with an authorised capital and investments in shares. The capital will vary with size and nature of the cultivated and the cultivable area of an unit. (D. R. O's division as Parliamentary electorate) and the needs of the cultivators. A share should not exceed Rs. 2·50 in order to attract every cultivator in a unit to be a shareholder and enjoy the benefits of the movement. The tentative objects of these guilds will be as follows :—

(*a*) *To procure and hire out tractors, &c., to cultivators.*—This will be confined to flat countries like N.-C. P., E. P., N.-W. P., N. P. and S. P. As it is, cultivators have to wait for the rains and in most cases till the tank is full to begin cultivation operations. This method involves waste of precious water and delay in commencement and completion of cultivations. This has often resulted in low yields and failure of paddy crops. If tractors are made available, ploughing and harrowing which form the most difficult part of a paddy cultivator's job, can be done during dry weather. This will enable the cultivators to adhere to a uniform programme of work, make maximum use of rain water, save up tank water, &c., and thereby eliminate the failure of crops—which is an ever recurring source of disappointment to the cultivator.

(*b*) *To procure and make available to cultivators agricultural implements at almost cost price., e.g.,* light iron ploughs, Burmese harrows, mamoties, &c. At present there is a fair demand for light iron ploughs and I do not think the Agricultural Department can meet this—Mamoties are sold at high prices and this is hard for the cultivator.

(c) *To procure and make available to cultivators fencing materials.*—The time has come when the cultivator is called upon to rely on something other than nature to solve this difficult problem. With the felling of jungle and expansion of agricultural extents the villager is at a loss to find the means of protecting his cultivations. The live-fence sounds well but this does not give sufficient protection against semi-wild cattle or even herds of the domesticated cattle. Therefore, we have to evolve a better and sounder method of protecting village paddy cultivations. An Agricultural Guild will be in a position to procure concrete fence posts and barbed-wire and make these available to the cultivator on a hire-purchase system basing the price a little above the cost—This will be the greatest boon to a cultivator.

(d) *To maintain Buffalo Farms and hire out to cultivators at economic rates.*—Although tractors would be available *vide* (a) above, buffaloes for threshing, &c., are necessary. Today the "have-nots" have to depend on the "haves" for buffaloes and they have to pay prohibitive rates.

(e) *To give loans to* bona fide *applicants among members of the guild, for cultivation purposes.*—This will remove that usurious trader from a cultivator's scheme of things and this would be to his great advantage—This aspect will over-lap with the objects of Co-operative Credit Societies. Since both these institutions would exist for the benefit of the cultivators, there can be no charge of under-cutting. Recoveries of loans will be made in kind.

(f) *To establish and encourage subvention seed farms.*—This will increase the pure-line seed paddy in a unit.

(g) *To establish paddy and other produce purchase centres.*—This is very necessary for the welfare of our cultivators. The middle-man will be thrown over-board and the cultivator will derive maximum benefit.

(h) *To establish milling centres.*—This is a great asset to an agricultural guild and its members.

(i) *Generally to promote agriculture within its sphere.*—My scheme may appear too far-reaching and somewhat beyond the capabilities of the average farmers, who will form the bulk of the membership, but left to themselves, it is bound to fail for lack of organising talent. It is for this reason that I suggest that the Propaganda Branch of the Agricultural Department should step in and do the pioneering work in setting up this great national project—For success, I suggest that we take up one electorate in N.-C. P. and concentrate our attention there—This is the time to start a thing of this nature as financial support of the cultivator can be expected in view of the I. P. S. There is no doubt that this will be a success as it is most opportune and necessary, if we in Ceylon are to attain some standard of agriculture. The old methods must yield to new, and the Government which helps in these matters will even be acknowledged a good Government."

This resolution was postponed as the mover was absent.

(iv.) Gate Mudaliyar M. S. Kariapper formally moved,—

"That this Board is of opinion that as the present system of inquiring into offences committed under the Irrigation Ordinance in V. T. Courts caused considerable hardships to the villagers in the Batticaloa District owing to the length of time involved in obtaining redress, Government should revert to the practice of appointing Irrigation Presidents, as early as possible."

Mudaliyar Kariapper had sent the following arguments in support :—

"The resolution is self-explanatory. Prompt disposal of irrigation cases makes more than 50 per cent. all the difference between the success and failure of a crop. This is essentially so in the Batticaloa District, where paddy fields are paddy fields only for three months and are pasture grounds during the rest of the year. This, so to say, co-ownership of the land between the paddy plant and the cattle, requires the ever-watchful and quick eye of the law to prevent aggression. And what's more, the present-day cultivation labourers, styling themselves "Cooly-men" (a class in their opinion a wee bit superior to "gentlemen") are developing a spirit of indifference in regard to fencing, watching, &c., that unless the rod of the law is ever present for prompt application to their back, paddy cultivation will become merely the growing of fodder for cattle, wild beasts and birds."

Gate Mudaliyar M. S. Kariapper emphasised the need for having separate Irrigation Presidents to deal with irrigation offences which are now tried in V. T. Courts and said that most of the cases are not disposed of expeditiously.

Gate Mudaliyar N. Wickremaratne seconded this motion.

The Chairman asked for Mr. Taylor's views on the subject.

Mr. Taylor replied that irrigation offences, &c., were matters for the G. AA.

Mr. C. A. M. de Silva inquired why it affected only Batticaloa District and why Mudaliyar Kariapper was trying to revert back to the old system.

Mudaliyar Kariapper replied that those irrigation cases were recently transferred to the Gansabhawa where a great deal of time was taken to dispose of such cases, whereas if Irrigation Presidents were trying those cases as it would be their only work, they could dispose of such cases more expeditiously.

Mr. L. B. de Mel inquired whether such a procedure would not affect the whole Ordinance.

Dissawa Poholiyadda said that in the North-Central Province and the North-Western Province those cases were tried by Irrigation Presidents and later on, in about the year 1925 they were transferred to V. T. Courts where the work has since become very heavy. He said that in the North-Central Province those cases were tried by people deputed by the Government Agent and later the Government Agent found it difficult to get persons deputed by him to cope with the work. He said that somewhere in 1925 the G. A. deputed his Chief Headmen to try those cases. But they themselves could not cope with the work because institutions were so very heavy. In most cases they appealed to the Governor and then the Attorney-General had observed that as long as there was a certain amount of law to be exercised in those cases they should be tried by an officer with a knowledge of the law. He added that for the last four or five years those irrigation offences were tried by V. T. Presidents who had complained of heavy work with which they were unable to cope . He, however, requested the Board to make enquiries from various Government Agents whether they have felt the necessity to appoint separate men for this purpose.

Mudaliyar Kariapper accepted the suggestion of the Dissawa and said that under irrigation offences a very large number of cases came up for hearing. He suggested that the Board should consider whether it was safe and whether it was in the best interests of the cultivator to adopt the system proposed and whether additional staff could be given to G. AA. for that purpose.

Chairman suggested the postponement of that motion.

Mr. Simon Abeywickrema, M.S.C., suggested that it be referred to the Minister of Agriculture and be taken up in the next meeting, and he moved that it be referred to the Agricultural Committee and that the necessary information be given at the next meeting.

The Chairman said that that motion could not be referred to the Minister unless it was passed by the house

Mr. Simon Abeywickrema inquired how such a resolution could be passed without sufficient data. He explained that it was a request from the Board that the necessary information be obtained from Government Agents.

Chairman—" I want to know whether you would mind if the matter is taken up at the next meeting. We can only submit passed resolutions to the Minister."

Gate Mudaliyar Kariapper had no objection to the Chairman's suggestion for a postponement of that motion.

Mr. C. A. M. de Silva agreed with Mr. Simon Abeywickrema that it was in order to call for that information from G. AA. through the Minister.

The Chairman however inquired whether the Board had any objection if the Director of Agriculture would get the necessary information from different sources and place the matter at the next meeting.

The house agreed and a final decision on the matter was postponed.

(v.) Gate Mudaliyar M. S. Kariapper formally moved :—

" That in view of the fact that efforts of the cultivators to obtain better results in paddy cultivation are vitiated by ravages caused by wild and tame animals, this Board is of opinion that Government should undertake the supply of barbed wire to the cultivators of the Batticaloa District and recover the value in instalments in cash or kind."

Gate Mudaliyar Kariapper had sent the following arguments in support :'—

" The motion is self-explanatory. Incidentally I may add that a lot of barbed wire came recently into the Batticaloa District and quickly sneaked off into the N.-C. P., within a couple of weeks for use there. Reasons for this strange behaviour is not known. Probably we were allowed to enjoy only the " visual value " of the stuff. Definitely what was left behind was a lingering sense of resentment in our minds."

Gate Mudaliyar N. Wickremeratne seconded the motion.

Mr. Simon Abeywickrema inquired from where the barbed wire came to the Batticaloa District. He said that no one was aware whether the barbed wire referred to was stolen or even private property. The main object of the resolution too, in his opinion was not worth discussing because it was absolutely impracticable to implement the motion.

Poholiyadde Dissawe said that Mudaliyar Kariapper might be speaking of what happened in the North-Central Province some years back, and perhaps he was not aware how the barbed wire came to that Province. He said that various people had requested the Government Agent for barbed wire. The Government Agent had said that he was prepared to provide barbed wire if satisfactory arrangements were made for the recovery of its value. He said that a large amount of barbed wire was distributed on this understanding and people even cultivated larger extents than they normally did, but somehow they were never prompt in their repayments. He said that there were still thousands of rupees due from the people on those issues. He also said that some barbed wire which was not wanted by the G. A. had been given to some cultivators and now every cultivator neglected his farm and asked for barbed wire if it was to be cultivated.

At this stage Gate Mudaliyar Kariapper agreed to withdraw his motion. Gate Mudaliyar Wickremaratne, the seconder of the motion too consented. The house agreed and the motion was withdrawn.

(vi.) Gate Mudaliyar M. S. Kariapper moved—

" That as Co-operative Credit Societies which are tied down to short-term loans only, cannot solve the problem of chronic indebtedness of the agrarian middle-class Ceylonese especially of the country side, who require long-term loans for purposes such as

the purchase of cattle or paddy land or for repayment of prior debt carrying heavy rate of interest, this Board is of opinion that Land Mortgage Banks should be established in agricultural areas, particularly in small towns like Kalmunai with a view to granting adequately secured long-term loans repayable by easy instalments from sale proceeds of surplus stock of several years."

Gate Mudaliyar Kariapper had sent the following arguments in support :—

"The present source of such financial assistance is the local money-lender who charges excessive rate of interest and ultimately dispossesses the borrower of his land. The State Mortgage Bank and other institutions do not lend money on Batticaloa lands as the title in most cases is not considered sound. If local Land Mortgage Banks are established, even in the absence of a clear title to a land, on the evidence of a responsible person of the District testifying to the ownership and possession of the land, deserving cultivators could obtain loans. In India, Land Mortgage Banks are functioning with great advantage to middle-class Indians. Why should we be denied this blessing ? This idea really is not mine. It is the idea of that great Ceylonese Sir P. Ramanathan. Sir P. Ramanathan is dead but his idea lives. It is now your proud privilege to give it tangible form and shape."

Gate Mudaliyar N. Wickremaratne in seconding the motion said that certain attempts had been made in the Anuradhapura District to give financial assistance in the way suggested and as the repayments were not prompt, 2 years grace was allowed and eventually the borrowers had ceased to make any payments. He said that those rules framed in the Co-operative Societies for the release of loans have been amended or abolished and now the Co-operative Societies were giving only short term loans which he felt was good only for cultivators of short term crops, who could sell their produce and repay the debt. Therefore he felt that there were many advantages if Mortgage Banks could be established in such areas.

Mr. K. Kanagasabai said that he had put that matter forward as early as 1940 but yet the question of how those Mortgage Banks should be established still remained unsolved.

The motion was put to the house and carried unanimously.

(vii.) Gate Mudaliyar M. S. Kariapper formally moved :—

"That this Board requests the Director of Agriculture to be good enough to get the paddy cultivation experiment of the Colombo Municipal Engineer investigated by a competent technical body, and to publish the result for the information of the public."

Gate Mudaliyar Kariapper had sent the following arguments in support :—

This paddy cultivation stunt raising hopes of a miraculous yield, has been given through newspaper publicity with the result that we paddy farmers are left wondering if we are really at the threshold of a revolution in paddy cultivation or if we are reading a chapter in "The Arabian Nights." It is cruel to allow us to to hug false hopes. Hence the need for an early authoritative statement after a scientific study of the Colombo experiment."

Mr. Bandara Dharmakirti seconded the motion.

Mudaliyar Kariapper said that the publicity given in the press about the paddy experiment of the Municipal Engineer had given false hopes to paddy cultivators who were looking forward for the day when they could find themselves millionaires, if that method of paddy cultivation could be extended to their fields too. He said that it was time they harvested the full crop and gave some definite information about their success or failure without misguiding the public.

Dr. D. E. V. Koch, Acting Chemist of the Department said that a few officers of the Department had inspected the experiment plot at Jawatte. He had from time to time examined samples of the Electro Magnetically treated water. He said that in general the treated water had a trace of nitrate and apart from that, there was nothing on which one could comment. He also said that the Department had decided to purchase one of those machines from the Municipal Engineer. The price orginally was Rs. 200 but it had gradually risen to Rs. 600. All efforts hitherto to purchase a machine were without success. He added that a machine could not be obtained on loan either. However, Mr. Wickremasinghe had offered a petrol-driven machine for Rs. 2,500. He observed that the plot planted by Mr. Wickremasinghe was very rich in cattle manure and that the crop of 60 bushels he had harvested could be attributed to that fact. He also remarked that according to the newspapers a part of the crop and one machine had been stolen.

Gate Mudaliyar N. Wickremaratne stated that as Mudaliyar Kariapper had said, that paddy experiment on paper, had been a parable or a chapter from the Arabian Nights. He himself had visited the place and had a look. He had told one of his friends who had praised the success of that experiment that they were more of straw than paddy. Those paddy plants were nearly 5 ft. high, whereas village cultivators normally prune the plants if they grew to such heights and then only a satisfactory crop could be expected.

Dr. A. W. R. Joachim, Acting Deputy Director said that the Department had been very interested in that matter and has asked the Municipal Engineer to supply whatever information was available on the results of these trials. He said that so far as was known to the Department, the experiment was not yet complete. He stated that when information about the experiment was received it would be placed before the Board.

Dr. W. R. C. Paul said that he had watched the experiment from the very beginning and that he had pointed out to Mr. Wickremasinghe that it was very unfortunate that he had no control plot to compare the harvest of the electro-magnetically treated paddy with a plot cultivated on ordinary lines. He said he had observed a large quantity of cattle manure in that plot, probably from the dairies there. The actual success of the experiment could not be judged because the plot had been heavily manured.

Mr. C. A. M. de Silva was of opinion that the Department should have given a plot to Mr. Wickremasinghe to try out his experiment and that the Department should be the "watch dog."

The Chairman said that Mr. Wickremasinghe was attached to another Department and it was not possible for this Department to get him to try the experiment.

The Motion was put to the house and unanimously passed.

VII.—ANY OTHER BUSINESS.

(i.) Mr. Simon Abeywickrema proposed that the following information be tabled at the next meeting :—

(1) A report on the work of the Agricultural Corps.
(2) Progress of the work at Bopatalawa and Ambewela farms.
(3) A report on the work of the Minneriya Scheme.

Col. T. Y. Wright supported Mr. Abeywickrema and requested that the expenditure on the three schemes should also be furnished at the next meeting.

(ii.) Mudaliyar Kariapper inquired whether the venue of the Board Meetings could not be arranged at a more convenient place in Kandy.

Mr. Simon Abeywickrema supported Mudaliyar Kariapper's suggestion and said that the School of Agriculture was a very inconvenient place and that even the road leading to the spot was very bad. He felt that as the emergency period was over the Board should get back its board room.

Mr. M. J. Perera, Secretary to the Board explained that the Room in which the Board used to meet was required for other purposes by the Department and was no longer available for this purpose.

The Chairman however said that the matter would be taken up with the Director.

(iii.) The next Board meeting was fixed for the third Monday in February. There being no other business the meeting terminated at 1 P.M.

Col. T. Y. Wright complimented the Chairman, Mr. H. W. Amarasuriya for the very efficient manner in which he had gone through such a wide Agenda and remarked that that was about the first time that the whole agenda had been gone through fully.

M. J. PERERA,
Secretary, Central Board of Agriculture.

Peradeniya, January 15, 1947.

MINUTES OF THE ELEVENTH MEETING OF THE PADDY ADVISORY BOARD

The Eleventh meeting of the Paddy Advisory Board was held in the Department of Agriculture Library at 2.30 P.M. on Monday, February 24, 1947.

Mr. Malcolm Park, Deputy Director of Agriculture, presided. The following members were present :—Rev. Fr. L. W. Wickremasinghe, Messrs. P. B. Bandaranayake, R. H. de Mel, A. M. Clement Dias, and K. J. Gunawardene (Secretary). The Agricultural Engineer of the Dept, of Agriculture was present by invitation. Messrs. A. Arulambalam, U. B. Unamboowa and U. B. Alawwa had intimated their inability to attend the meeting.

CONFIRMATION OF MINUTES.

The minutes of the 10th meeting of the Paddy Advisory Board were confirmed.

ACTION TAKEN ON MINUTES OF THE LAST MEETING.

The Chairman stated that the resolution of Mr. Arulambalam " That this Board is of opinion that the subsidy of Rs. 50 per acre hitherto granted by Government for asweddumization of new fields be continued for a further period of two years or until such time as when Ceylon would become self-supporting with regard to her food requirements ", was forwarded to the Minister of Agriculture and Lands.

Re the resolution of Gate Mudaliyar Kariapper " that this Board is of opinion that in the Dry Zone areas of Ceylon where adequate tank irrigation or evenly distributed rainfall is absent, and where therefore, the need is very essential for developing and utilizing subterranean water supplies, the Government should sell to paddy farmers on easy hire-purchase system, agricultural pumps in order to introduce the comparatively more economical and more efficient mechanical methods of lifting water namely irrigation by pumping, " the Chairman stated that the D. S. S. had been written to, requesting him to approach Crown Agents to obtain quotations for such pumps, in order that the financial implications of this motion could be fully appreciated.

Next the suggestion of Fr. Wickremasinghe on the possibility of puddling and levelling the paddy fields by the use of the caterpillar tractor was taken up. The Agricultural Engineer pointed out that the presence of water in the fields and the sandy nature of the soils would prove such operations being undertaken very expensive. The levelling operation could be done best in the dry condition by the use of the scoop, scraper or bulldozer.

ACTION TAKEN ON PREVIOUS RESOLUTIONS.

The following replies were received from the Minister of Agriculture and Lands in regard to resolutions forwarded to him :—

(*a*) Resolution on " Chairman of Paddy Advisory Board."

Minister's reply : " The D. A. is now the Chairman of the Paddy Advisory Board and this no longer arises."

(*b*) Resolution on " Wild Paddy in the Batticaloa District ".

Minister's reply : " The D. A. reports that an investigation is being undertaken by the D. A. O."

(*c*) Resolution on " Tropical Agriculturist and Departmental Pamphlets."

Minister's reply : " The motion may be given effect to."

AGRICULTURAL MACHINERY.

The Chairman reviewed the position regarding tractors as at 1.12.46 and pointed out that the number in Ceylon was not sufficient for cultivating Government farms &c. These were certainly not enough for loaning out to private individuals. The supply position was unsatisfactory and it was unlikely that any new tractors would be available until 1948. The A. E. expressed the view that light tractors with self-propelled implements hydraulically manipulated as in the Ford Ferguson tractor would be likely to be the best type for Ceylon conditions. Light tractors were on order and after comparative trials with different types it was hoped that it would be possible to make a general recommendation.

Mr. R. H. de Mel expressed the view that buffaloes were less expensive than tractors for cultivating coconut estates and asked if comparable figures were available for paddy cultivation. The Chairman undertook to table figures at the next meeting.

USE OF MACHINERY IN DEEPENING TANK BEDS.

Fr. Wickremasinghe stated that the capacity of many tanks, *e.g.*, Dabarawewa and Tissawewa was greatly reduced by the silting up of the tank bed. He asked if it would not be possible to increase the capacity of tanks by removing this silt. The A. E. was of the opinion that this work could be undertaken during dry weather by means of scrapers.

The following resolution was adopted :—

> " This Board is of opinion that the capacity of certain tanks, *e.g.*, Dabarawewa and Tissawewa has been and is being reduced by the deposition of silt. The Board recommends to the Minister of Agriculture and Lands that the Director of Irrigation be asked to investigate the possibility of increasing the effective water holding capacity of such tanks by removal of deposited silt by the use of scrapers drawn by D 8 tractors during periods of dry weather."

MEETINGS.

It was decided to hold the next meeting in Colombo on May 28, 1947. It was further agreed that a meeting should be held in August or September at a Government Farm to enable members of the Board to see mechanised cultivation of paddy.

There being no other business, the meeting terminated at 4 P.M. with a vote of thanks to the Chair.

J. GUNAWARDENE,
Secretary, Paddy Advisory Board.

Peradeniya, March 10, 1947.

MINUTES OF THE TWELFTH MEETING OF THE PADDY ADVISORY BOARD

THE twelfth meeting of the Paddy Advisory Board was held in the Committee Room of the Chamber of Commerce Building, Colombo, at 10 A.M. on Wednesday, May 28, 1947. Mr. Malcolm Park, Deputy Director of Agriculture, presided. The following members were present :—

Rev. Fr. L. W. Wickremesinhe ; Gate Mudliyar M. S. Kariapper ; Dissawa P. B. Bulankulama, M.S.C. ; Messrs. R. H. de Mel ; A. M. Clement Dias ; A. Arulambalam ; U. B. Alawwa ; K. J. Gunawardene (Secretary). Mr. P. B. Bandaranayake intimated his inability to attend the meeting.

CONFIRMATION OF MINUTES.

The Minutes of the 11th Meeting of the Paddy Advisory Board were confirmed.

RESIGNATION.

The Chairman read a letter from Mr. V. Subasinha tendering his resignation from the Board. It was decided to report this to the Chairman of the Central Board of Agriculture and to ask that a successor be appointed.

ACTION TAKEN ON MINUTES OF THE LAST MEETING.

The reply received from the Director of Irrigation to the motion on the silting and de-silting of tanks in the Hambantota district was read out by the Chairman. In that reply the Director of Irrigation expressed the opinion that increasing the capacity of a tank to any degree by the removal of silt from its bed is such a costly undertaking as to preclude its adoption. He further indicated that there was little evidence to show that the water-holding capacity of any of the major tanks had been markedly reduced as a result of the deposition of silt.

In this connection the Rev. Fr. Wickremasinha stated that not many years ago, to his knowledge, Tissawewa had held enough water to irrigate 3,000 acres of paddy during both seasons. During the last two or three years many acres of land under that tank have gone out of cultivation. He had been of the opinion that the shrinkage was due to the reduction of the capacity of the tank owing to the deposition of silt. If this was not the case what was the explanation ? The Chairman undertook to inquire from the Director of Irrigation.

RELATIVE COST OF PRODUCTION.

Copies of statements of comparable figures for the cost of cultivation of paddy by animal and manual labour as compared with the costs using tractor drawn machinery were distributed among members.

ACTION TAKEN ON PREVIOUS RESOLUTIONS.

On the question of Portable Dams for the Batticaloa district the Director of Irrigation reported that action had been taken to prepare suitable disigns, and on their completion a further communication would be addressed to the Board.

Ref. the resolution on Agricultural Pumps the Chairman drew the attention of the members to a smaller pump which was available in one of the Colombo firms. He stated that

this was not suitable for purposes of irrigation in paddy cultivation as it could at the most irrigate a small area of about 6 acres. The Crown Agents had been written to regarding more suitable pumps and a reply was expected in due course.

DAMAGE BY WILD BOAR.

On the subject of the serious damage to paddy cultivation in the Eastern Province by wild boar, the Chairman, stated that he had interviewed the Commissioner for the Development of Agricultural Marketing to ascertain if it would be possible to create such a market for the disposal of carcasses that shooting of wild pigs would be more profitable than at present. The Commissioner for the Development of Agricultural marketing had indicated that there was an abundance of pork in the market at present and that he could not extend the present facilities for the disposal of carcasses. After some discussion the following resolution was adopted—

> " That this Board is of opinion that as an incentive to the destruction of wild pigs which do much damage to paddy cultivation in the Eastern Province, the Minister for Agriculture and Lands should authorize the Government Agent, Eastern Province, to pay a bounty of Rs. 2 plus two cartridges to every person who produced the tail of a wild pig ".

CONTROL OF PADDY FLY.

Gate Mudliyar Kariappar inquired what was the latest position regarding the control of paddy fly. The Chairman stated that promising results had been obtained in India by the use of Gammexane, a new insecticide. Steps were being taken to get a quantity of this insecticide for trial by the Entomologist and he promised, in due course, to acquaint members with the results.

STIMULATION OF PADDY CULTIVATION.

(*a*) *Price of Paddy.*—The Board discussed generally the prospect of paddy cultivation and it was considered by most members that the price at present paid was inadequate. It was decided, however, that the Chairman should circularise members in order, is possible, to obtain reliable figures for the cost of production of paddy in different districts. Further, it was felt that a clear statement of policy from Minister of Agriculture and Lands regarding the price of paddy would be of great value in stimulating paddy production. The Chairman was therefore instructed to write to the Minister of Agriculture and Lands and to state that, in the opinion of the Board it was most desirable that a statement of Government's policy regarding the future price of paddy should be issued at an early date.

(*b*) *Modification of Internal Purchase Scheme.*—The Rev. Fr. Wickremesinha expressed the opinion that at the present time, the organisation of the Internal Purchase Scheme for paddy was unnecessarily cumbersome and expensive. He felt that the Scheme had been going for long enough now for cultivators contributions to the Scheme to be assessed on the basis of the purchases made from them over the period of operation of the Scheme. He suggested that the money so saved should be utilized for paying a bonus on all paddy in excess of the assessed quantity surrendered voluntarily by cultivators. The Board considered the suggestion a good one and the Chairman was instructed to write to the Minister for Agriculture and Lands accordingly.

MEETINGS.

It was decided to hold the next meeting in one of the Government Farms at Maha Illuppallama or Hingurakgoda on about October 7, 1947. The meeting terminated at 11·30 A.M. with a vote of thanks to the Chair.

J. GUNAWARDENA,
Secretary, Paddy Advisory Board.

Peradeniya, June 13, 1947.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE EIGHTY-THIRD MEETING OF THE RUBBER RESEARCH BOARD HELD IN THE SECRETARIAT, COLOMBO, AT 2.30 P.M., ON TUESDAY, APRIL 8, 1947

Present.—Mr. L. J. Seneviratne, C.C.S. (in the Chair) ; Mr. H. E. Peries, C.C.S. (Deputy Financial Secretary) ; Mr. Simon Abeywickrema, M.S.C. ; Mr. Thomas Amarasuriya, M.S.C. ; Mr. W. H. Attfield ; Mr. C. A. C. Bowen ; Mr. Neal de Alwis, J.P. ; Mr. W. P. H. Dias, J.P. ; Mr. A. M. Clement Dias ; Mr. Noel de Silva ; Mr. J. D. Farquharson ; Mr. R. J. Hartley ; Mr. F. A. Obeyesekere ; Mr. R. C. L. Notley ; and Col. J. T. Young.

Dr. E. Rhodes, Director, was present by invitation.

1. MINUTES.

(*a*) *Minutes of last Meeting.*—Draft minutes of the meeting held on December 19, 1946 which had been circulated to members, were signed by the Chairman on signification of members, assent that they were in order.

(*b*) *Matters arising from the Minutes.*—

(1) *Dartonfield Approach Road.*—Reported that the road had been repaired by the D. R. C.

(2) *Smallholdings Committee.*—Agreed that this matter be considered by the Director and his views placed before the Board for consideration at a later meeting.

2. BOARD.

The following changes in membership were reported ; the incoming members were welcomed and the outgoing members thanked for their services :—

(*a*) Mr. Thomas Amarasuriya, M.S.C., had been nominated as representative of the State Council with effect from October 15, 1946, in place of the late Mr. R. C. Kannangara.

(*b*) Mr. F. J. C. de Mel (representing the L. C. P. A.) had resigned and Mr. T. C. A. de Soysa had been nominated in his place with effect from January 30, 1947.

(*c*) Mr. J. D. Farquharson had been nominated by the Planters' Association of Ceylon to act for Mr. F. H. Griffith during the latter's absence from Ceylon, with effect from February 15, 1947.

(*d*) Mr. A. W. Harrison (representing the R. G. A.) had resigned and Mr. R. J. Hartley had been nominated in his place, with effect from March 14, 1947.

(*e*) Mr. E. J. O. Richardson (representing the C. E. P. A.) had resigned and Col. J. T. Young had been nominated in his place with effect from April 1, 1947.

3. REPORTS AND ACCOUNTS.

(*a*) *Acting Director's Report for the 4th quarter, 1946*—was adopted.

(*b*) *Statement of Receipts and Payments for the 3rd quarter, 1946*—was adopted.

(*c*) *Finance.*—The Scheme's finances were considered in relation to its programme of development, and the long-term position was noted.

The transfer to current account of two deposits amounting to Rs. 19,000 and the realization of an investment of Rs. 50,000 were reported.

(*d*) *Estate Accounts, June to December, 1946*—were tabled.

(*e*) *Supplementary Votes.*—A supplementary vote of Rs. 1,725 was passed to cover the cost of furniture for 3 newly appointed officers and equipment for the estate office and dispensary

4. **EXPERIMENTAL COMMITTEE.**

(*a*) *Membership.*—Mr. Thomas Amarasuriya was nominated to serve on the Committee during the absence of Mr. F. H. Griffith.

(*b*) *Recommendations made at meeting of April 8, 1947 :*

(1) *Visiting Engineer*—The Visiting Engineer's annual fee was increased as recommended by the Committee.

(2) *Estimates for labourers' cottages.*—Estimates for the construction of ten sets of twin cottages were approved.

(3) *Junior Staff Water tank.*—An estimate for enlarging the junior staff water tank was approved.

(4) *Planting 60 acres at Hedigalla.*—The recommendation that 60 acres be cleared at Hedigalla for planting the seedlings derived from the 1945 hand pollinations at Nivitigalakele was approved and the necessary vote passed.

(*c*) *Recommendation made at meeting of September 16, 1946 :*

Workmen's Compensation.—The recommendation that the Scheme's of insurance against accidents for which compensation is payable under the Workmen's Compensation Act should be extended to cover contractors' employees was approved.

5. **STAFF.**

(*a*) *Director.*—Reported that Dr. E. Rhodes had assumed duties as Director on February 26.

(*b*) *Senior Staff.*—A Sub-Committee was appointed to consider the revision of senior staff emoluments.

(*c*) *Botanist.*—The Sub-Committee mentioned above was asked to consider the appointment of a second Botanist.

(*d*) *Geneticist.*—The Sub-Committee mentioned above was asked to consider the appointment of a Geneticist.

(*e*) *S. H. P. O.*—An application from the S. H. P. O., for one month's vacation leave was approved.

(*f*) *Secretary-Accountant.*—Reported that Mr. C. D. de Fonseka, Secretary-Accountant, had returned from study leave and resumed duties on February 28.

(*g*) *Research Assistants.*—Reported that the posts had been advertised for the third time but that no suitable applications had been received.

(*h*) *Junior Staff.*—A deputation consisting of three members of the Junior Staff presented their case for improvement of their salaries and terms of service. A Sub-Committee was appointed to consider the matter.

The meeting then adjourned.

Dartonfield,
Agalawatta, April 26, 1947.

C. D. DE FONSEKA,
Secretary-Accountant.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE ADJOURNED EIGHTY-THIRD MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE SECRETARIAT, COLOMBO, AT 2.30 P.M., ON MONDAY, MAY 12, 1947

Present.—Mr. L. J. de S. Seneviratne, C.C.S. (in the Chair); Mr. Simon Abeywickreme, M.S.C.; Mr. Thomas Amarasuriya, M.S.C.; Mr. W. H. Attfield; Mr. W. Neal de Alwis, J.P.; Mr. W. P. H. Dias, J.P.; Mr. A. M. Clement Dias; Mr. T. C. A. de Soysa; Mr. Noel de Silva; Mr. J. D. Farquharson, J.P.,U.M.; Mr. A. D. Layton; Mr. R. C. L. Notley; Mr. F. A. Obeyesekere and Col. J. T. Young.

Dr. E. Rhodes, Director, was present by invitation.

Apologies for absence were received from Mr. H. E. Peries, C.C.S. (Deputy Financial Secretary), and Mr. R. J. Hartley.

1. MINUTES.

(*a*) *Minutes of last meeting.*—Draft minutes of the meeting held on April 8, 1947, which had been circulated to members, were signed by the Chairman subject to the inclusion of Mr. T. C. A. de Soysa's name in the list of members present.

(*b*) *Matters arising from the minutes*—

(1) *Small-holdings Committee.*—The Director's memorandum regarding the work of the Small-holdings Department was considered and it was agreed that he should supply further detailed information regarding the work of the Rubber Instructors.

(2) *Yield at Nivitigalakele.*—The Director's memorandum was considered and it was noted that the drop in yield was due partly to the change in tapping system and partly to the re-institution of the winter rest.

2. BOARD.

The Chairman reported that Mr. A. D. Layton had been nominated by the Rubber Growers' Association to act for Mr. C. A. C. Bowen with effect from April 1, 1947.

3. NEW RUBBER PLANTING SCHEME.

At the request of the Director of Agriculture it was agreed that a short course of training in tapping be given to the Range officers of the N. R. P. S.

4. PUBLICATIONS.

The following publications were tabled :—

(*a*) Annual Report for 1945.

(*b*) Combined Quarterly Circulars for 1946.

5. **STAFF.**

(*a*) *Senior Staff Salaries Committee.*—The recommendations of the Senior Staff Salaries Committee were adopted as follows :—

(1) *Salaries of Senior Staff.*—Agreed that the war allowance payable to Senior Officers be increased by Rs. 110 per month.

(2) *Botanist.*—Agreed that a second Botanist with a leaning towards plant breeding should be appointed.

(3) *Secretary-Accountant.*—A new salary scale for the Secretary-Accountant was approved.

It was also agreed that a new contract be offered to Mr. M. W. Philpott, Chemist, and that Dr. L. A. Whelan, Soils Chemist, be allowed to postpone his end of contract leave until February or March, 1948.

(*b*) *Junior Staff Salaries Committee.*—The report of the Committee was considered and its recommendation that salary scales should not be altered at the present time was adopted.

(*c*) *Changes in Junior Staff.*—Changes in the junior staff since the last meeting were reported.

6. **EXPERIMENTAL COMMITTEE.**

(*a*) *Visiting Agent.*—It was noted that Col. K. D. H. Gwynn was unable to continue as the Scheme's V. A., and it was agreed that Mr. W. A. Paterson be asked to make a special visit to the Scheme's estates.

(*b*) *Gallawatta Chummery.*—Agreed that the tenancy of the Gallawatta bungalow be terminated and that the officers who now occupy it be housed in the new chummery at Dartonfield.

(*c*) *Secretary-Accountant's bungalow.*—An estimate for providing electricity, drainage and water-service to this bungalow was approved.

7. **REPORTS AND ACCOUNTS.**

(*a*) *Annual Report for 1946.*—was adopted.

(*b*) *Statement of Receipts and Payments for the 4th quarter, 1946*—was approved.

8. **COLONIAL OFFICE SCHOLARSHIP SCHEME.**

Details of the Colonial Office Scholarship Scheme for the training and subsequent employment of research officers was considered and it was agreed that the Research Scheme should not participate.

The meeting then terminated.

Dartonfield,
Agalawatta, June 6, 1947.

C. D. de Fonseka,
Secretary-Accountant.

COCONUT RESEARCH SCHEME, BOARD OF MANAGEMENT

MINUTES OF THE 86TH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 2.30 P.M., ON MONDAY, APRIL 28, 1947, IN ROOM No. 202, NEW SECRETARIAT, COLOMBO

Present.—Mr. L. J. de S. Seneviratne, C.C.S. (Chairman) ; Mr. H. E. Peries, C.C.S., Acting Deputy Financial Secretary ; Mr. C. A. M. de Silva, Chairman, L. C. P. A. ; Mr. E. Muttukumaru ; Mr. Stanley Dias ; Mr. G. Panditteseker, J.P., U.M. ; Mr. Thomas Amarasuriya, M.S.C. ; Col. W. G. Mack, O.B.E., E.D. ; Mr. Vernon Rajapakse ; Mr. D. D. Karunaratne, J.P. ; Dr. R. Child, Director ; Mr. S. C. Kahawita, Secretary.

An apology for absence was received from Mr. J. Tyagaraja, M.S.C.

Minutes :

The minutes of the previous meeting held on March 3, 1947, which had been circulated were confirmed.

Board of Management.

The Chairman in congratulating Mr. C. A. M. de Silva on his re-election as Chairman of the L. C. P. A. for the current year and as an *ex-officio* member of the Board paid a tribute to the regularity of his attendance at meetings of the Board.

Staff.

(*a*) *Appointment of Botanist.*—The Board unanimously decided to offer the post of Botanist to Dr. T. S. Raghavan, Professor, and Head of the Botany Department, Annamalai University, South India.

(*b*) *Field Assistant.*—(i.) The appointment of Mr. D. P. Wijesinghe as a Field Assistant to the Botanist as from May 1, 1947, was ratified.

(ii.) As sanctioned at the previous meeting, the promotion of Mr. C. W. S. de Silva to the post of Senior Field Assistant to the Botanist with effect from January 1, 1947, was approved.

(*c*) *Technical Assistant.*—As a special case the two months, April 15, 1947, to June 15, 1947, full pay study leave granted to Mr. D. V. Liyanage, Technical Assistant to the Botanist was approved.

Sub-Committees.

Estates.—In discussing the minutes of the third meeting of the Estates Sub-Committee, which had been circulated to the Board, the following recommendations were approved.

(i.) Repairing of the existing harrows even at a higher cost than the price of a new harrow.

(ii.) A supplementary vote of Rs. 1,028 for repairing the roads was approved.

(iii.) That an immediate start should be made with the removal of dud-palms in the estates section and replace them with seedlings.

(iv.) The making of bricks at Ratmalagara estate at Rs. 18 per 1,000 was approved.

(v.) Trials should be made at Ratmalagara estate of ground nuts as inter crops for coconut palms.

MINUTES OF THE 87TH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 10.30 A.M., ON SATURDAY, JUNE 21, 1947, AT BANDIRIPPUWA ESTATE, LUNUWILA

Present.—Mr. L. J. de S. Seneviratne, C.C.S. (Chairman) ; Mr. H. E. Peries, C.C.S., Acting Deputy Financial Secretary ; Mr. C. A. M. de Silva, Chairman, L. C. P. A. ; Mr. E. Muttucumaru ; Mr. Stanley Dias ; Mr. C. Panditesekera, J.P., U.M. ; Mr. Thomas Amarasuriya, M.S.C. ; Mr. A. Pearson ; Mr. Vernon Rajapakse ; Mr. D. D. Karunaratne, J.P. ; Dr. R. Child, Director ; Mr. S. C. Kahawita, Secretary.

MINUTES.

The minutes of the previous meeting held on April 28, 1947, which had been circulated were confirmed.

STAFF.

The Board agreed to the Director's request that he be granted full pay leave out of Ceylon from July 9, 1947, to the last week of August or the first week of September.

Dr. Child agreed to accept the grant of leave and passage as a full settlement of any facilities still outstanding on contracts prior to his existing agreement.

The Board agreed to meet the costs of a sea passage from U. K. to Ceylon for Dr. Child's wife.

ESTATES.

Monthly reports on the estates for April and May which had been circulated were approved.

The disposal statement of the first crop for 1947 which had been circulated was approved.

ANY OTHER BUSINESS.

On three consecutive Sundays in May an advertisement was published in the " Silumina " regarding the distribution of Sinhalese Leaflets.

It became necessary to call off the advertisement after the third Sunday as most of the twelve leaflets available for distribution were exhausted.

The Board decided that the Director and the Staff should revise the leaflets to bring them up to date, reprint them as early as possible, and distribute them after giving the necessary publicity.

SOIL CHEMIST'S STUDY LEAVE.

The Board considered an application for study leave in 1948 from the Soil Chemist. The Director had minuted this saying that it was a good plan to allow study leave to scientific officers. The Board decided that the Director should put up a considered plan of study for the approval of the Board, who would be prepared to grant the leave likely to be of benefit to the Scheme's work.

The meeting terminated at 11·55 A.M. with a vote of thanks to the chair.

AN APPRECIATION

BY

Sir Frank A. Stockdale, G.C.M.G., K.C.M.G., K.B.E.

THE LATE MR. W. MOLEGODA, J.P., M.B.E.

It was with the deepest regret that I received the news of the death of Walter Molegoda, and I am confident that a very wide circle of agriculturists in Ceylon will feel this loss most deeply.

Walter Molegoda was the true friend of the Ceylonese peasant and he was untiring in his efforts to improve village agriculture and to increase the efficiency and earning powers of the producers. Few men of Ceylon have done more than Walter Molegoda to assist the village cultivator.

He started his work as an Agricultural Instructor in the employ of the Ceylon Agricultural Society, and was subsequently absorbed into the service of the Department of Agriculture. When I was in charge of that Department I always found Walter Molegoda devoted to his work, full of initiative and always ready to help. From what I have heard since I left Ceylon, I understand that this loyal work and devotion to village agriculture was continued until his retirement a few months ago. If fact it has been put to me that when he filled a staff appointment in the Department of Agriculture as Agricultural Officer (Propaganda) he did his best work. I was able to follow some of the work of this section of the Department whilst it was under his charge, and there is no doubt it was well done.

Walter Molegoda was a loyal servant of the Ceylon Government Department of Agriculture. He was hard working and had a great fund of knowledge about village agriculture and life. He always devoted himself to the service of these producers. In the Department of Agriculture he was a colleague with whom it was always a pleasure to work.

He corresponded with me occasionally after I left Ceylon, and his letters were always full of news of achievement and progress and of the part which he was endeavouring to take in these developments. His last communications were in connection with his son, who is now studying in England and who my wife and I have tried to help in his loneliness away from home.

By the death of Walter Molegoda, Ceylon has lost one of her devoted sons, who throughout his life served her village agriculturists to the utmost of his capacity. He will be greatly missed.

To Mrs. Molegoda and her family my wife and I send our sincerest sympathies. We were both very sorry indeed to hear of his sudden death and feel that another link with those whom we know well in Ceylon has been broken.

June 12, 1947. (Sgd.) F. A. STOCKDALE.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED APRIL 30, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	Deaths	Recoveries	Balance Ill	No. shot.
Western Province	Foot-and-mouth	44	236	17	207	12	—
Colombo Municipality	Piroplasmosis	2	2	—	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	17	59	59	—	—	—
Cattle Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	4	25	25	—	—	—
Northern Province	Foot-and-mouth	42	289	15	235	39	—
North-Western Province	Rabies	—	1	1	—	—	—
	Mange	—	26	14	—	12	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	517	517	33	417	67	—
Southern Province	Foot-and-mouth	32	141	—	109	32	—
	Rabies	—	4	1	—	—	3
	Black Quarter	6	6	6	—	—	—
Central Province	Foot-and-mouth	17	971	7	636	328	—
	Anthrax	—	3	3	—	—	—
	Rabies	—	2	2	—	—	—
Eastern Province	Foot-and-mouth	15	2797	135	2662	—	—
Province of Uva	Foot-and-mouth	85	1871	46	177	46	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, June 8, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED MAY 31, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to May 31, 1947. Deaths	Recoveries	Balance Ill	No. shot
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	11	70	70	—	—	—
Colombo Cattle Quarantine Station	Foot-and-month	—	18	—	18	—	—
	Anthrax	—	25	25	—	—	—
Northern Province	Foot-and-mouth	142	431	17	—	268	146
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	15	41	14	12	15	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	384	901	92	708	101	—
Southern Province	Foot-and-mouth	56	197	—	134	63	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	27	998	7	964	27	—
	Anthrax	—	3	3	—	—	—
	Rabies	—	2	2	—	—	—
Eastern Province	Foot-and-mouth	—	2797	135	2,662	—	—
Province of Uva	Foot-and-mouth	103	1974	58	1,891	25	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, June 27, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED JUNE 30, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to June 30, 1947			
				Deaths	Recoveries	Balance Ill	No. shot.
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	9	79	79	—	—	—
Colombo Cattle Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	3	28	28	—	—	—
Northern Province	Foot-and-mouth	331	762	54	468	240	—
North-Western Province	Rabies	—	1	1	—	—	—
	(Mange goats)	—	41	14	25	2	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	—	901	92	809	—	—
Southern Province	Foot-and-mouth	92	289	—	123	166	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	1	999	7	992	—	—
	Anthrax	—	3	3	—	—	—
	Rabies	—	2	2	—	—	—
Eastern Province	Foot-and-mouth	—	2797	135	2662	—	—
Province of Uva	Foot-and-mouth	38	2012	70	1926	16	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, July 28, 1947.

4——J. N. A 72811 (7/47)

METEOROLOGICAL REPORT, APRIL, 1947.

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	88·4	—0·6	73·3	—0·2	86	98	6·8	7·16	22	— 6·23
Anuradhapura	90·3	—1·1	75·8	+1·3	74	93	5·0	2·75	8	— 3·68
Badulla	84·1	0	65·9	—0·4	80	95	5·0	6·85	13	— 0·15
Batticaloa	87·9	+0·1	76·5	—0·3	82	91	6·4	2·59	6	+ 0·29
Colombo	87·7	—0·2	77·3	+1·4	75	86	6·6	4·83	16	— 4·24
Diyatalawa	77·2	—0·6	61·6	+1·1	78	89	6·1	10·23	20	+ 3·69
Galle	85·2	—1·0	78·3	+1.6	82	86	5·4	8·85	12	+ 0·14
Hakgala	73·2	—0·8	56·6	+1·4	80	91	6·4	6·01	11	— 0·97
Hambantota	88·6	+0·9	76·7	+0·4	83	91	7·1	5·33	5	+ 1·47
Jaffna	88·4	—1·1	81·2	+1·2	78	83	4·5	0·22	4	— 2·01
Kandy	87·8	—0·4	70·0	0	75	92	5·1	5·38	11	— 1·11
Kurunegala	89·6	—1·5	75·4	+0·8	72	86	6·4	3·00	12	— 6·91
Lunuwila	87·6	—1·1	76·6	+1·1	80	93	6·4	3·98	12	— 2·86
Mannar	88·3	—2·1	79·7	+1·8	78	85	5·2	2·93	5	— 0·49
Nuwara Eliya	70·7	—0·6	51·4	+1·6	80	91	7·4	2·56	10	— 2·42
Puttalam	87·8	—1·5	77·6	+1·5	76	89	5·1	1·49	7	— 3·39
Ratnapura	90·3	—0·9	73·8	0	77	90	6·3	8·23	14	— 3·34
Talawakele	77·2	—0·4	59·1	+1.3	80	91	6·9	3·34	15	— 2·96
Trincomalee	89·5	+0·4	78·7	+1·1	70	82	5·7	4·46	6	+ 2·33

Rainfall in April was below normal over a major portion of the Island, larger deficits—of the order of 5 to 10 inches or more—occurring in the south-west quarter. The region worst affected was the western mid-country, comprising the Avissawella-Ambepussa area, where deficits exceeded 10 inches, the highest being 13.29 inches at Mayfair estate, 12.70 inches at Ruwanwella and 12.17 inches at Vincit estate. Monthly totals here were as low as 2 inches or less. The deficits in the north and east were generally below 2 inches.

Rainfall was a little above normal on the east side in an area roughly between Batticaloa and Trincomalee and extending up to the hills. Small excesses were also found in the extreme south and the eastern parts of Jaffna Peninsula. The largest excesses were 8.71 inches at Hapugastenne estate, 5.58 inches at Gammaduwa estate and 5.02 inches at Kebitigollewa.

Except in a few limited areas, monthly totals generally ranged from 2-5 or 5-10 inches, 5–10 inches occurring in the south-western parts of the Island, over a large part of the central hill-country and in a considerable area surrounding the hill-country. The highest totals were 23.72 inches at Hapugastenne estate, 16.75 inches at Carney estate, 16.32 inches at Kitulgala and 15.58 inches at Udahena estate. Rainfall was least, below 2 inches, in the western parts of Jaffna Peninsula, and in the Dandagamuwa-Kegalle area.

There were 6 daily falls of 5 inches or over for the month, the highest being 11.88 inches at Hapugastenne estate on the 8th.

The weather during April was again mainly of the inter-monsoon type, but thunderstorm activity was less pronounced than is usual for April, and rainfall which was practically confined to the periods 1st to 11th, and 14th–15th, was disappointingly poor.

Temperatures were below average by day and above average by night. The highest recorded shade temperature was 97.68 at Trincomalee on the 7th, while the lowest air temperature was 42.9° at Nuwara Eliya on the 26th. Humidities were above average, and cloud amounts generally in excess. Winds were variable, and above average strength.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

METEOROLOGICAL REPORT, MAY, 1947.

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	88·6	+1·8	74·1	—0·4	80	98	7·0	13·92	22	—12·96
Anuradhapura	93·3	+2·9	76·8	+0·6	68	91	4·1	1·27	5	— 2·27
Badulla	86·0	+0·8	66·4	0·	75	95	4·3	1·01	10	— 3·68
Batticaloa	90·5	+0·3	77·5	—0·3	76	89	6·0	0·05	2	— 1·74
Colombo	88.0	+1·1	77·0	—0·5	78	88	6·4	18·02	21	+ 2·53
Diyatalawa	77·2	—1·5	61·9	—0·1	78	92	4·4	5·22	17	— 0·84
Galle	86·5	+1·7	79·0	—1·1	80	86	5·3	15·29	13	+ 2·62
Hakgala	74·2	+1·1	57·8	—0·2	78	86	6·3	6·80	12	— 1·64
Hambantota	88.6	+2·0	76·8	—0·6	80	88	7·0	5·61	12	+ 1·34
Jaffna	89·2	+1·2	82·1	+0·6	77	81	3·2	0·	0	— 2·00
Kandy	90·5	+3·6	70·1	—0·9	71	92	4·8	1·28	8	— 6·29
Kurunegala	91·8	+2·8	75·9	0·	68	86	5·8	2·11	12	— 5·44
Lunuwila	88·1	+0·6	76·7	—0·4	80	93	6·6	7·19	16	— 4·74
Mannar	89·5	+0·1	80·5	—0·1	77	85	5·0	1·52	5	— 0·27
Nuwara Eliya	72·1	+1·7	50·3	—3·0	80	93	7·0	5·06	14	— 3·41
Puttalam	89·3	+1·2	78·0	—0·8	76	89	4·4	1·55	10	— 2·22
Ratnapura	91·7	+3·1	74·6	—0·2	75	88	6·2	10·05	21	—10·86
Talawakele	78·8	+3·5	58·2	—1·7	81	91	5·4	6·84	15	— 2·57
Trincomalee	93·0	+1·2	78·9	+0·2	72	82	5·2	2·13	5	— 1·10

For the third successive year rainfall in May was disappointing in the regions where it matters, viz:—the south-western parts of the Island. Except for small excesses at a few coastal stations, rainafall was below normal over the whole of this area, deficits in the central parts of the south-western quarter including the south-western slopes of the hills exceeding 10 inches, the largest deficits being 20·88 inches at Watawala, 19·75 inches at Kenilworth estate and 19.60 inches at Norton Bridge. The region worst affected was the south-western slopes of the hills where the monthly totals were less than a quarter of the average. Thus, Watawala received only 4·86 inches against an average of 25·74 inches, Norton Bridge 5·09 inches against 24·69 and Theydon Bois Group 5.24 inches against 23·62. The total at Watawala was the lowest on record for May for 36 years during which observations are available there, while those at Norton Bridge and Theydon Bois Group exceeded only slightly the lowest on record for 20 years, which occurred in 1945.

Rainfall was a little above normal in the south-eastern parts including the Haputale Hills and in some limited areas in the north east. The largest excesses were 7·91 inches at Meeriyabedde estate, and 7·65 inches at Sudupanawela.

A day of unusually heavy rain for the south-western coastal belt extending from Negombo to Weligama was the 28th, when 18 stations recorded falls over 5 inches. The centre of this heavy rain was located near Dehiwala which recorded 9.02 inches, Ratmalana coming a close second with 8.88 inches. These were the highest daily falls for the month. The heavy rain experienced in this area on the 28th contributed in a large measure to make up the high monthly totals that occurred in the south-western coastal regions, *e.g.*, 24.75 inches at Bandaragama, 19.60 inches at Kumbaduwa estate, 19.45 inches at Ratmalana and 19·19 inches at Dehiwala. Rainfall was over 10 inches in the south-western foot-hills, while elsewhere in the south-west it ranged from 5 to 10 inches. In the north and the east the totals were generally about 2 to 3 inches, a few stations reporting no rain at all.

Although evidence of the approaching monsoon was available as early as the 10th, the heavy rains in the western and south-western low-country that usually follow shortly thereafter were once again lacking, and very little rain was experienced until the 25th.

Temperatures were above average by day and slightly below averge by night. The highest recorded shade temperature was 97·8° at Batticaloa on the 28th, while the lowest air temperature was 44·4° at Nuwara Eliya on the 5th. Humidities were irregularly distributed, and cloud amounts were in deficit. Winds were generally south-westerly.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

METEOROLOGICAL REPORT, JUNE, 1947.

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	86·0	+0·9	74·0	—0·2	84	98	7·9	25·04	29	+ 7·58
Anuradhapura	90·0	+0·4	77·2	+0·9	70	86	6·8	0·73	5	0
Badulla	86·1	+0·8	66·5	+1·2	68	89	6·1	0·82	5	— 0·72
Batticaloa	93·3	+1·1	77·6	0	66	80	8·1	0·03	1	— 0·86
Colombo	85·9	+0·5	77·8	+0·5	79	86	8·8	10·55	26	+ 1·89
Diyatalawa	76·9	—0·7	64·2	+1·1	68	79	5·8	0·30	3	— 1·66
Galle	84·5	+0·9	77·3	0	82	89	6·8	9·73	24	+ 1·29
Hakgala	67·7	—1·0	59·7	+1·5	84	84	8·4	2·75	13	— 3·86
Hambantota	84·5	—2·1	76·4	—0·4	87	91	9·2	8·51	18	+ 6·40
Jaffna	87·1	+0·5	81·5	+0·7	80	81	7·0	0	0	— 0·39
Kandy	85·0	+1·7	72·3	+1·1	77	88	8·6	3·52	26	— 5·31
Kurunegala	87·5	+1·0	76·3	+0·8	78	88	8·2	6·75	25	— 0·04
Lunuwila	85·9	+0·3	77·0	—0·1	83	91	8·6	8·32	24	+ 0·66
Mannar	88·4	+0·2	81·4	+0·8	76	81	7·8	0·04	2	— 0·32
Nuwara Eliya	65·5	—0·3	56·7	+1·1	84	85	9·4	4·13	26	— 6·30
Puttalam	86·7	+0·4	79·1	—0·1	79	84	7·2	1·73	11	+ 0·33
Ratnapura	87·1	+0·5	74·8	+0·1	80	90	7·0	20·16	29	+ 1·61
Talawakele	72·1	+1·3	61·4	+1·0	88	94	8·6	6·30	28	— 6·98
Trincomalee	92·4	+0·3	79·7	+0·7	66	78	8·0	0·01	1	— 0·92

Rainfall in June was well distributed throughout the month in the South-western parts of the Island where there was rain practically every day. The highest totals occurred in the adjacent parts of Kalutara and Ratnapura districts and on the south-western slopes of the hills where the rain fall exceeded 20 inches, Kokkawitta Group recording 26·59 inches, Blackwater estate 25·43 inches and Carney estate 25·25 inches. Gonapenigala estate, Agalawatta and Sirikandura estate also reported totals over 25 inches. Rainfall gradually decreased towards the north and east, an in the north-eastern parts the monthly totals were below two inches. There was practically no rain to north of Trincomalee.

Rainfall was appreciably below normal on the south-western slopes of the hills, where June averages are high. At a number of stations the deficits exceeded ten inches, the highest being 17·74 inches at Kenilworth estate, 16·45 inches at Watawala, 15·10 inches at Onoogaloya estate, 14·76 inches at Norton Bridge and 14·07 inches at Ingoya estate. The largest excesses occurred in the south *e.g.*, Panilkanda estate 9·28, inches and Anningkande estate 9·01 inches There were also appreciable excesses, 2-5 inches in parts of Chilaw and Puttalam districts.

There were 10 daily falls of 5 inches or over during the month majority of them occurring on the 1st. The highest recorded on this day was 6·45 inches at Mawarella estate.

South-west monsoon weather was in control during June, and the rains which were typically monsoonal were very nearly confined to the south-west quarter. Particularly wet days were the 1st and 5th-8th. During the last third of the month, only light to moderate rain was experienced.

Temperatures were above average. The highest recorded shade temperatures was 97·6° at Batticaloa on the 27th, while the lowest air temperature was 53·8° at Nuwara Eliya, also on the 27th. Humidities were above average by day and generally below average by night. Cloud amounts were in excess. Winds were south-westerly, and above average strength.

D. T. E. DASSANAYAKE,
Superintendent Observatory.

The

Tropical Agriculturist

JULY TO SEPTEMBER, 1947

EDITORIAL

LOCAL FEEDING STUFFS

THE price of milk in Colombo now stands at the level of sixty cents a pint and the harassed consumer has almost given up wondering which would come down first, the price of his milk or the percentage of water in it. Most of the Colombo suppliers have dairies within the city itself, so that the now well-known truism that milch cows can be successfully fed on grass and grass products alone does not mean much to them. Dairy owners depend entirely on concentrates for the production ration for their animals and justify the preposterous figure for milk by the plea that the price of concentrates is so high.

It is difficult, however, to avoid the uncomfortable feeling that a good portion of their expenditure can be eliminated by a more scientific feeding of their cows. A good deal of what is spent in cattle food is very probably carried away in the dung and waste matter that a punctilious sanitary authority insists on being expeditiously removed. Unfortunately, however, while money can be made from milk these days without reference to production costs, the complacent dairy owner is not likely to expend his energies in putting new ideas into practice. But if he does, this is a sure way of benefiting himself by a remunerative return and of reducing the price to the consumer.

It is impossible, at the same time, to deny that the price of concentrates is indeed very high and this will remain so while we are dependent on what other countries can spare. Our million acres of coconuts should supply a very substantial part of our feed requirements in the form of poonac. But this will not be achieved until steps are taken to prohibit the export of all the products of the coconut kernel except the oil.

The result of this highly inflated price of animal food has been that cattle breeders and dairy owners have been thinking furiously of possible alternatives and numerous and startling have been the suggestions put forward. As is usual in a time of crisis, the inevitable cry has been raised, " What is the Department of Agriculture doing ?" and one important association expressed the view that if " efforts were made in existing State Farms to cultivate fodder crops and grain like kurakkan, gingelly, maize and soya bean, the difficulties of the livestock breeder would be greatly reduced and he would be in a position to increase the production of meat, milk, eggs

and pork". The letter did not go to the length of explaining why the kurakkan, gingelly, maize and soya bean could not be consumed by the human population direct; but, be this as it may, the pious hope that prompted the proposal did not, it is feared, take account of the practical implications.

One acre of gingelly, for instance, will yield about 160 lb. of poonac, if the harvest is satisfactory. This is enough to provide a cow in milk with its gingelly poonac ration for one-fourth of its lactation period. Hence 4 acres of gingelly are needed to feed one cow in milk for its entire lactation period. Similarly, 1 acre of maize will yield about 1,000 lb. in a good year. This will be enough to feed about 22 birds for a year, so far as the grain ration is concerned. A simple calculation on these lines will show that little can be done with the few thousand acres under the control of the Department of Agriculture; it will show, moreover, the futility of embarking on a scheme of self-sufficiency as a short term policy. The aim is indeed a desirable one and is also one that is capable of realization. But it cannot be achieved by the waving of a magic wand. Hard work over a long period with adequate planning is the only means.

The first step is to make a careful analytical survey of all the produce in the Island that can be utilized as animal food, but which are now being allowed to run to waste. The Chemical Division of the Department of Agriculture has made considerable headway with this particular task. Even the mineral constitutents of the more important feeding materials have been ascertained. The food crisis was responsible for suggestions of a most desperate character as solutions for our feeding problems. Even these have not been overlooked. The present number of this journal contains the final instalment of these analyses.

From this mass of data, it is possible now to select the most promising material for further examination. The next step will be to test the assimilability of these selected foodstuffs. Digestibility trials are being undertaken by an officer who has recently returned from India after training. After these trials are over, special attention will have to be paid to those materials which, while of high analytical value, show only low assimilability. Means of processing these materials so that animals absorb a higher proportion of the nourishment in them will have to be investigated. An allied problem is to devise simple processes for improving the digestibility of popular feeding materials. Rice straw, for instance, is a common cattle feed in this country, but its assimilability has been notoriously poor. This has been found to be due to the presence of oxalates. By steeping the straw in water or in a dilute solution of caustic soda, a proportion of the oxalates can be removed and the digestibility correspondingly increased. This is a notable Indian discovery, the adoption of which in this country will be to its advantage. Similarly, coconut poonac can be even more effective as a stock feed if its oil content can be slightly reduced.

Side by side with this work of investigation, the extension of the area cultivated for animal food will have to proceed. The possibility of utilizing grass and grass products alone for feeding purposes must not be overlooked, especially as the productivity of our indigenous cattle with regard to milk is so low. Step by step by patient investigation and the rapid adoption of proved results, a system for providing adequate supplies of animal food must be built up.

PASTURE PROBLEMS OF THE LOW COUNTRY WET ZONE

BY

W. R. C. PAUL, M.A., M.Sc., Ph.D.

INVESTIGATIONS into the problems of establishing and maintaining pastures for livestock at the Agricultural Stations of the low country wet zone were commenced early in 1946. Hitherto, cattle on these stations were largely stall fed on the hand cut green fodders from the tall perennial grasses—Napier (*Pennisetum purpureum* Schum.) and Guinea (*Panicum maximum* Jacq.)—which were grown as perennial forage crops. The animals received a ration of about 40 lb. per head of green material and during part of the day they were confined to paddocks of limited extent. The herbage was composed of inferior grasses such as Doob (*Cynodon dactylon* (L) Pers.), Carpet grass (*Axonopus compressus* (Swartz.) Beauv.), Running grass (*Digitaria longiflora* (Retz.) Pers), Love grass (*Chrysopogon aciculatus* Trin.) and the wild kurakkan (*Eleusine indica* Gaertn.). The areas were generally overgrazed and as a result of the constant treading several bare patches frequently developed. Light shade usually prevailed with trees of coconut, jak, mango and some miscellaneous wild species all of which were widely spaced. As soon as the arable crops in the rotation areas on the Stations were harvested, the stock were introduced for grazing on the stubble. Bullocks were provided in addition with about 20 lb. of paddy straw. This was the position on the Agricultural Stations prior to the establishment of pastures.

Elsewhere in the low country wet zone cattle gained access to inferior pastures on roadside verges, on coconut land, on paddy fields in the intervals between successive crops and in small holdings. There were no areas under permanent pasture despite the past attempts to create without success so-called communal pastures.

The striking results achieved in certain sub-tropical and intermediate regions, notably in Britain, with temporary leys as an advance over the previous system of permanent pastures stimulated interest in the problem of establishing pastures in Ceylon, even though tropical conditions prevailed. There is, in fact, no record of any work on sown or high production grasslands except in the montane zones of the tropics. The absence of good natural pastures can be attributed to the rainfall and high temperature. Where the rainfall is excessive, the rain forest becomes the climax, unless drainage is impeded, and where it is sparse or unevenly distributed the savannah type of grassland prevails. It is, generally, believed that a cool climate and a well distributed rainfall are conducive to the growth of high quality grass.

In place of pastures, fodder grasses such as Napier and Guinea referred to above are grown without much difficulty under good rainfall conditions. Yields of fresh fodder ranging from 25 to 50 tons per acre are obtained from about 8 to 10 cuttings per annum, depending on the fertility of the soil, the

cultural and manurial treatments, the rainfall and the age of the crop. The cost, however, of cutting and transporting these fodders from the fields where they are grown to the cattle sheds can be avoided with pasture grasses. Again, in comparison with pastures subject to correct management, especially in the early stages of growth, the nutritive value of fodder grasses is low. Another disadvantage of fodder grasses is that under a system of ley farming where land under grass is alternated with arable crops for improvement of soil fertility, the removal of the grass after a few year's cropping becomes difficult and costly on account of the heavy mass of woody rootstocks. The soil is also rendered less fertile in comparison with pastures because of the frequent cutting and removal of the leaves and stems and the consequent loss—in the absence of grazing—of the droppings of the stock that make a considerable contribution towards the increase in fertility of the pasture. Animals fed on good pastures have been found to thrive better and in the case of milk cows give a somewhat higher milk yield than those fed on the green fodders of Napier and Guinea grasses. This is probably due to the fact that on pastures the stock are afforded opportunities for greater exercise and more food over the longer period of time spent in grazing. They are also able to consume food which is more palatable and more nutritious because of the greater variety of grass, legumes and herbs in a pasture mixture. Fodder grasses are, however, useful when grown on small extents of land, to supplement outside grazing of a few animals and when cutting and transport costs are low.

When this work was undertaken, there were no pastures either natural or established in the low country wet zone except the trial plots of Mr. R. H. Spencer Schrader at Wester Seaton Farm, Negombo, the selected grass being *Brachiaria distachya* Stapf. Elsewhere, the areas that are frequently and consistently grazed are the roadside verges and banks. Examination of the composition of the pasture shows the following species to be common, each being confined to its own small area.

Love grass (*Chrysopogon aciculatus* Trin.)
Carpet grass (*Axonopus compressus* (Swartz.) Beauv.)
Doob or Bermuda grass (*Cynodon dactylon* Pers.).

These grasses are spreading perennial types and occur with *Desmodium triflorum* DC. (S. *Hin-undupiyali*) so that the advantages of the grass legume association are maintained. Although these verges are regularly grazed by village cattle and constitute the main grazing grounds of such cattle, the amount of leafy growth produced is poor and there is little or no change with grazing in the composition of the species forming the sward.

Love grass forms too close a mat to be of much value as a pasture grass. It produces stiff erect flowering stalks and those patches of this grass which are in flower at any time are avoided by cattle on account of the sharp barbed points of the spikelets. Carpet grass which grows extensively in the West Indies, Florida and Australia forms a dense prostrate cover of broad leaves and though it stands up to heavy grazing it is not sufficiently productive. Its nutritive value is also not high. Seeds moreover, are difficult to collect as they are shed as soon as the flower emerges. This grass thrives best under shade and moist soil conditions. Doob though grown extensively along with carpet grass in the south-eastern states of U. S. A. (1) does not produce much leaf growth, the individual leaves being too fine. It develops extensive rhizomes and stolons

which render their complete removal difficult after the grass has been established for a few years. It is therefore unsuitable for inclusion in temporary leys where the pasture has to be ploughed up after a few years for sowing arable crops in rotation.

Other grasses found growing commonly under coconuts, in small holdings and on waste land in which village cattle graze frequently are—

Digitaria longiflora Pers. xxx
D. sanguinalis (L) Scop. (D. marginata Link) oo
Dactyloctenium aegyptium (L) Richt xxx
Eleusine indica Gaertn. xxx
Sporobolus diander Beauv. xxx
Ischaemum ciliare Retz. xx
I. timorense Kunth xx
I. muticum Linn. x
Paspalum metzii Steud. x
Eragrostis tenella P. Beauv. *ex* R. & S. xxx
E. viscosa Trin. xxx
Perotis indica O. Ktze. xx
Setaria lutescens C. E. Hubb. xx
Echinochloa colonna Link. xx
Alloteropsis cimicina Stapf xx
Chloris barbata Sw. x
Crytococcum trigonum A. Camus ooo
Paspalum conjugatum Bergius oo
P. commersonii Lamk. oo
Stenotaphrum dimidiatum Brogn. oo
Paspalidium flavidum A. Camus oo

xxx Most frequent under open conditions.
xx Frequent under open conditions.
x Less frequent under open conditions.
ooo Most frequent under shade conditions.
oo Frequent under shade conditions.
o Less frequent under shade conditions.

The species found growing commonly in the open were of little value because the quantity of leafy material produced from each is small. In most cases, flowering takes place quickly and the proportion of flowering stems to leafy stems is high. With the exception of *Digitaria longiflora* and *Paspalum metzii*, the seeds are not palatable to stock. The former is more useful as a lawn grass because it remains prostrate, the creeping stems growing close to the ground and the flowering stems remaining short with the racemes inconspicuous. *P. metzii* is a tufted perennial with prostrate leaves. Amongst the species growing under shade, *Stenotaphrum* produces satisfactory leaf growth but it possesses creeping rhizomes and does not flower sufficiently well to permit of ready seed collection. The others are not sufficiently leafy for consideration as pasture grasses.

Other indigenous grasses which occur with much less frequency but which are prominently leafy types with a stoloniferous habit of growth are :—

Brachiaria distachya Stapf.
B. miliiformis Chase

B. ramosa Stapf
Brachiaria paspaloides (Presl) C. E. Hubb. (*Hemigymnia javanica* Alst.)

These species flower readily and produce much seed which is consumed by cattle. The fresh three species of *Brachiaria* grow more satisfactorily and seed better than the last. The only species that was found in sufficient quantity for the collection of planting material was *B. distachya* and it was selected for the initial trials. *B. miliiformis* is the largest plant of the three, while *B. ramosa* is the smallest but it possesses the largest seeds which are prominently ovoid.

The following exotic grasses growing in Ceylon were examined :—

Chloris gayana Kunth. Rhodes grass.
Tricholaena repens (Willd.) Hitch. Natal red top.
Pennisetum clandestinum Chiov. Kikiyu.=*P. villosum* R. Br.
Melinis minutiflora Beauv. Molasses grass.
Paspalum dilatatum Poir. Dallis grass.

Rhodes grass is undesirable because it produces small leaves and forms rhizomes which render complete removal of the grass difficult when the pasture has to be alternated with arable crops. Natal red top besides producing rhizomes, flowers too profusely and its wind blown seeds tend to reduce it to the category of a weed. It should be eradicated wherever it appears. Kikiyu has grown well on the wet *patanas* (montane grasslands) at Bopatalawa Farm (5,000 ft.) but when introduced in the low country at Walpita and Ambepussa Farms its vegetative growth was not as good. It does not seed but develops extensive rhizomes and it was therefore quickly removed after one season's trials. Planting material of *Melinis* was not available in sufficient quantity for trials but in small observation plots the grass has grown well and gives indications of being promising in pastures. *Paspalum dilatatum*, a South American grass introduced from Australia about 47 years ago is now commonly grown in the montane zone especially along banks, roadside verges, lawns and against ridges as a soil conservation measure. It is a semi-erect perennial which produces a considerable amount of leaf growth in proportion to flowering shoots which are also readily formed. The flower and seed heads are palatable to stock. The species was therefore selected amongst the exotic grasses growing in Ceylon and though it has been in existence for many years it was hitherto not successfully introduced in the low country. It is reported to be more nutritious and productive than Carpet grass (1) in the south-eastern states of the U . S. A., but it is subject to attack by ergot (*Claviceps paspali*). Fortunately, cases of poisoning are reported to be rare as the affected seeds have to be eaten in quantity to be toxic. So far, this disease has not been recorded in Ceylon. This grass was selected together with *Brachiaria* for the low country wet zone pastures—the one with a tufted and the other with a spreading habit so that they would combine to make a good sward for grazing. Neither of these two grasses develops rhizomes and they are, therefore, suitable for temporary leys. Guinea grass, one of the two main fodder grasses in the Island, was also included in a pasture trial in combination with *Brachiaria*, as it was considered to be also useful as a tufted pasture grass to be grown in association with a spreading type.

With regard to the legumes which form a necessary component of pastures, the following were examined :—

Local species.

Desmodium triflorum D. C. (S. *Hin-undupiyali*)
D. heterophyllum D. C. (S. *Maha-undupiyali*)
D. heterocarpum D. C. (S. *Et-undupiyali*)
Alysicarpus vaginalis D. C. (S. *Aswenna*)

Exotic species.

Desmodium ovalifolium Wall.
Stylosanthes gracilis H. B. & K. Brazilian lucerne.

Desmodium triflorum is the commonest species found growing in association with grasses on roadside verges, waste lands, small holdings, lawns and under coconuts. It grows well both in the open and under shade and on poor and rich soils alike. Its leaflets are, however, too small and its habit of growth too prostrate for its use as a pasture legume. The flower heads are also too small to permit of ease in seed collection. *D. heterophyllum* possesses larger leaflets ($\frac{1}{2}$–1 in. long) and flower heads and it is also of fairly wide distribution but it tends to become too aggressive and thus assumes the position of a dominant in the pasture. *D. heterocarpum* is less common and though its leaflets (1–1$\frac{1}{2}$ in. long) and flowers are larger than those of *D. heterophyllum* its stems become woody. *D. ovalifolium*, which is a popular cover crop on rubber estates, possesses even larger leaflets (1–2 in. long) and flowers, but unless grazed down regularly it tends to develop woody stems. It does better under shade and it was selected as one of the legumes for planting in pastures under coconuts. *Alysicarpus* does not occur with the same frequency as *D. triflorum* or *D. heterophyllum*, being prevalent chiefly on loams and sandy soils even along the coast. Its leaves measure $\frac{1}{2}$–1$\frac{1}{2}$ in. long and the stems, which do not become woody, develop radially from the base. When this legume is grown in association with grasses its stems intertwine amongst the leaves of the grass plants thus enhancing its value in grazing as a pasture legume. It flowers and seeds well and the entire plant is readily eaten by stock. It possesses a deep tap root which enables it to stand up to drought well. It was thus selected as a promising legume for pastures. *Stylosanthes* is a new legume to Ceylon, seed of which was introduced in 1946 from Australia where it is popularly called Stylo. It is a South American plant which has been grown with success in Queensland. The seed was sown in small observation plots at Walpita and Ambepussa Farms on May 20, 1946. Excellent growth took place and large upright bushes with deep tap roots developed. Flowering occurred on March 18, 1947, and seed was collected from April 28, 1947. The stems became woody, but under grazing they remain short, green and leafy. Stock exhibited reluctance at first to eat this plant but later when it was planted out in the pastures they became accustomed to it and now graze it down quite readily. This species showed remarkable resistance to the spells of prolonged dry weather which were experienced in 1946–47 when there was little or no rain for periods of 6 to 8 weeks and while all other standing crops including grasses and other legumes were suffering from the effects of the lack of sufficient moisture in the soil, *Stylosanthes* remained unaffected. It can be

propagated from seed as well as cuttings, but the seed heads take much time to develop and as the seed matures unevenly they should be picked while still green. This legume was selected for trials in pastures along with *Alysicarpus* and under coconuts with *D. ovalifolium* and *Alysicarpus*.

The third component of pastures are the miscellaneous herbs which from the animal nutrition point of view are considered essential in providing the mineral salts which are lacking in grasses and legumes. They should fulfil the following conditions (2) :—

(1) Palatability and absence of woody tissues.
(2) High mineral value.
(3) Ability to stand up to grazing.
(4) Restricted reproduction so as to avoid competition with the pasture grasses and legumes.
(5) Drought resistance.
(6) Easy collection of seed.

Deep rooted herbs are more valuable because they bring up nutrients from the lower layers of the soil. A number of different herbs were examined and those which have so far proved most promising are :—

Asystasia gangetica T. Anders (S. *Puruk*)
Ipomaea cymosa R. & S. (S. *Kiri madhu*).

These herbs can be grown from both seed and cuttings. *Asystasia* is an erect plant but unfortunately possesses a shallow root system while *Ipomoea* which grows as a creeper develops a deep tap root. Both herbs are readily eaten by stock.

Shade is essential for the stock during the hottest part of the day in the tropics. In the case of temporary leys it is not possible to establish shade trees in the pasture on account of the fact that ploughing and subsequent tillage operations for the successive arable crops which alternate with grass will be interfered with. Pasture herbage does better under shade than in the open and certain grasses such as *Stenotaphrum* and Carpet grass respond well to the shade factor. This is particularly so during spells of dry weather when the moisture content of soils under open pasture falls much more rapidly than those under overhead shade. The only way in which shade could be provided to the grazing stock so that fields under pasture could be rotated with arable crops is by establishing a belt of trees along the boundaries of the fields. This system will also serve the purpose of maintaining a wind break. The young plants will have to be protected from damage by the stock and this can best be done by running a double wire fence temporarily along the boundary with the avenue of trees between the two fences. An effective and quickly established shelter belt was found in the 18 months Singapore variety of jak which should be planted in 2 to 3 rows arranged quincuncially. Within 2 years the trees will grow to a satisfactory height and give protection both against sun and wind.

In the preliminary trials which have been laid down at the Agricultural Stations at Ambepussa, Walpita, Horana, Pasyala and Labuduwa in the low country wet zone the grasses, legumes and herbs were all established from stem cuttings or setts because seed could not in the first instance be collected in sufficient quantity and also because the viability of the seed of the grass

species was too low for sowing. The plots were given dressings of lime at 1 ton per acre, basic slag at 2 cwt. per acre and compost at 10 tons per acre. In the earlier plantings, the preparatory cultivation operations were inadequate and the intrusion of inferior grasses and weeds was much greater than in the case of the later plantings. The growth of the selected grasses and legumes was markedly superior in the plots which received lime and phosphate to the controls and this was especially so with the legumes.

Brachiaria and *Paspalum dilatatum* combine well as the grass components of a pasture to produce good herbage. While the *Paspalum* tends to remain tufted and semi-erect, the *Brachiaria* grows as a creeper which is semi-prostrate and occupies the space between the tufts. In the same way, *Brachiaria* and Guinea grass form a good combination of a creeping and a tufted species. Amongst the three species, Guinea grass is the most drought resistant, but it is not grazed down sufficiently close with the result that the base of the tillers become hard and woody to a height of about 4 to 6 in. In order to prevent the development of woody tissue at the base, the plants should, after complete grazing, be mown down to ground level with a motor or tractor drawn scythe. In the early stages of growth, *Paspalum* establishes itself quickly, while *Brachiaria* is slow, but later the *Brachiaria* grows more vigorously and if it is not grazed in time, it tends to overrun the pasture and to dominate the more palatable but less aggressive *Paspalum*. Flowering and seeding take place in all three species of grass and the mature ear heads are palatable to stock, but the germination of the seed still remains a problem. No methods have yet been found of inducing satisfactory germination and the vegetative methods of propagation such as rooted setts in the case of *Paspalum dilatatum* and Guinea grass and the rooted stoloniferous cuttings of *Brachiaria* have to be continued, but investigations on the viability of the seed are being continued.

Paspalum was soon attacked by paddy fly (*Leptocorisa acuta*) in the plots reserved for seed production at Ambepussa Farm. The pest was later observed also on *Brachiaria* but not to the same extent as in the case of *Paspalum*. The occurrence of paddy fly on the grasses when they are allowed to mature for seed renders them liable to be additional hosts for this pest and also affects the problem of raising seed of these grasses. Fortunately, in the plots which are regularly but rotationally grazed the pest is absent even though there may be a few plants in ear which have escaped being grazed, and moreover the pest is seasonal in its appearance. A caterpillar pest was also observed on *Paspalum* earheads, but it has not yet been indentified. A disease on the earheads of both *Paspalum* and *Brachiaria* has occurred resulting in the complete destruction of the seed in the affected earheads. At first, the individual spikes show a mucilaginous consistency and later the seeds become distorted and enlarged and appear as orange-coloured wrinkled masses, which finally turn a greyish black colour. The earlier stage of mucilaginous development appears to be caused by a *Sphacelia* which is followed by a *Cerebella*. So far these pests and diseases have appeared on the *Paspalum* and *Brachiaria* growing in the pastures only at Ambepussa Farm, but observations are being continued on their incidence and the extent of the damage caused to the grasses, before control measures can be devised.

Weeds constitute the major problem in the establishment and maintenance of pastures and if the most noxious are not removed early they multiply rapidly and overrun the pastures. The following is a list of the main troublesome weeds which appeared in the pasture plots of the Agricultural Stations of the low country :—

Grasses and sedges.

Dactyloctenium aegyptium (L) Right xxx
Sporobolus diander Beauv. xx
Eleusine indica Gaertn. xx
Eragrostis tenella R. & S. xx
E. viscosa Trin. xx
Digitaria longiflora Pers. xx
Cyperus zollingeri Steud. x
Perotis indica O. Ktze. x
Alloteropsis cimicina Stapf x
Cynodon dactylon (L) Pers. x

Annual herbs.

Mitracarpum villosum Ch. & Schl. xxx
Borreria ocymoides DC xxx
Mimosa pudica Linn. xxx
Vernonia cinerea Less xx
Synedrella nodiflora Gaertn. xx
Scoparia dulcis Linn. x
Euphorbia hirta Linn. x
Cleome tenella Linn. x
C. viscosa Linn. x
Amaranthus viridis Linn x
Mollugo stricta Linn. x

xxx Most frequent.
xx Very frequent.
x Frequent.

Mitracarpum and *Borreria* are the most noxious weeds amongst the annual herbs with *Dactyloctenium* as the most aggressive of the grass weeds. Early moving of the pastures is necessary to prevent these weeds seeding and spreading. When the preparatory cultivation of the soil is thorough and lime and basic slag have been applied in sufficient quantities the percentage of weeds present is low. Correct management of the pastures under controlled grazing will check the growth of weeds while hard grazing will bring about a deterioration of the sward. This latter condition took place in some of the trial plots at Walpita Farm which were subject to continuous grazing, with the result that the coarse and inferior grasses listed above invaded the pastures and the useful species disappeared. The paddocks which were grazed judiciously and rested at suitable intervals remained in good condition. They were divided and submitted to short and intermittent grazings. Further work is in progress on grazing rotations, but it does not appear possible to define the intervals of rest and the stock carrying capacity of pastures because these will depend on the prevailing rainfall and the fertility of the particular soil on which the pastures are grown. The stock should, therefore, be turned

into a field at certain times and for just sufficient periods for the pasture to be grazed down so that recovery will take place when it is rested of those components of the pasture that were planted. " The art of pasture management lies in knowing when to graze a field, how many animals to turn in, and when to rest it."

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SUMMARY

Pasture investigations were commenced in 1946 at the Agricultural Stations of the low country wet zone. An examination of the grasses, both local and exotic, growing in Ceylon was made for the purpose of determining their suitability in temporary leys. The superiority of certain species of *Brachiaria* as spreading types and of *Paspalum dilatatum* as a tufted type was revealed. *B. distachya* was selected for the initial trials as planting material of only this species was available in sufficient quantity. The promising legume components are the indigenous *Alysicarpus vaginalis* and the South American *Stylosanthes gracilis*, seed of which was received in 1946 from Australia. The miscellaneous herbs found suitable for pastures are *Asystasia gangetica* and *Ipomoea cymosa*.

Although these species combine well to produce good herbage in a pasture both in the open and under coconuts, the viability of the seed, especially of the grasses is not satisfactory. Pastures can, however, be established for the present by vegetative methods.

Shade is desirable for the stock during the hottest part of the day but as trees interfere with the cultural operations necessary in ley farming, suitable shelter belts can be established with the 18 months variety of jak along the boundaries of the fields.

Weeds constitute the most serious factor in the establishment and maintenance of pastures, those which appear with the greatest frequency being *Mitracarpum villosum*, *Borreria ocymoides*, *Mimosa pudica* and amongst the inferior grasses, *Dactyloctenium aegyptium*. Good preparatory tillage methods will reduce the incidence of weeds to a considerable extent.

Correct management of the pastures under intermittent grazing is essential to prevent their deterioration by the intrusion of inferior grasses and the disappearance of the useful species.

CHEMICAL NOTE No. 21

SOME INDIGENOUS FEEDINGSTUFFS OF CEYLON

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THE shortage of feedingstuffs in Ceylon has drawn the attention of livestock owners to the feasibility of utilizing waste materials from human foods and other materials not normally fed to cattle.

The existing supplies of feedingstuffs in the Island, as reported by Wright (1), for the $1\frac{3}{4}$ million cattle population is less than 10 per cent. of their requirements. These are comprised of rice straw and coconut cake in the main with very small amounts of gingelly cake, rice bran and rice sweepings. At present the whole of the balance requirements have to be met from grazing and cultivated fodder crops. There are no established pastures as such to any appreciable extent and the grazing available is limited. The acreage under fodder crops in Ceylon is so small as to be almost negligible. This necessitates the introduction of new feeds to replace or supplement the existing ones. In the search for new materials the quantities available, their distribution, and the economics of their utilization must be borne in mind.

A number of agricultural wastes and other materials have therefore been analysed for their proximate constituents as a preliminary step in ascertaining the possiblity of utilizing some of them as feedingstuffs. It should, however, be clearly understood that these analytical data are no indication of the actual nutritive value of these materials. It has been found that materials of a very similar chemical composition may have widely different nutritive values due to differences in the digestibility of their constituents. Before recommending a feedingstuff, its palatability and nutritive value should be ascertained. It is also necessary to see whether there are any harmful effects caused on prolonged feeding. To determine the nutritive value the material has to be fed to animals under strictly controlled conditions and the digestibility of the several constituents determined. Thus only will an estimation of the digestible crude protein and the total digestible nutrients

or the starch equivalent of these materials be made possible. As, however, the chemical analysis of any feedingstuff is an essential preliminary to the securing of the data referred to, this data is published.

TABLE I

Cassava tubers.—It is not advisable to feed cassava tubers in the fresh state as there is the possibility of prussic acid (hydrocyanic acid) poisoning. In the dried form as meal—the fleshy portion sliced, ground down and dried it is used for fattening pigs. Halnan (2) states that it can replace up to 25 per cent. of the total concentrate ratio fed. Yields of 40 tons of tubers per acre (equal to 13½ tons of meal) have been obtained in Ceylon. In times of glut the excess may be converted into meal for feeding livestock.

Jak and Breadfruit.—These are carbohydrate foods but are poorer in protein than the cereal grains. The dry materials from these are similar to the corresponding fresh material when compared on a moisture free basis. Boiling in the preparation of the flakes has had no marked beneficial effect. Jak meal was fed to dairy cows at the Experiment station, Peradeniya, on a very small scale in 1934. It was found that when soaked in water prior to feeding, cattle ate it readily mixed with other feeds and also alone. The economic production of jak and breadfruit meal is not impossible when times are more normal. At present they are greatly in demand as human foods.

Plantain Cabbage and Red Pumpkin Leaves.—The very high moisture percentage with consequent low food nutrient contents, make these ill-balanced feedingstuffs. The availability of these materials is limited.

Saccharum arunidnacum and Saccharum Spontoneum.—These are coarse grasses not normally eaten by cattle. When compared with good pasture and fodder grasses the protein is low and the material is very coarse. Trials with saccharum spontaneum at the Indian Veterinary Research Institute, Izatnagar, showed that this could be fed without ill effects to cattle. The investigation was made in connection with " Famine Fodders " for India. It was recommended that this grass be utilized only in times of great scarcity.

Sugar cane tops.—The protein in this material is low as compared with pasture and fodder grasses. Sugar cane tops are fed to cattle in India when the cane crop is harvested. The nutritive value of sugar cane leaves in the dry condition has been worked out by Indian workers, *e.g.*, Sen (3) who has found that the digestible crude protein is nil and the starch equivalent is low. Experiments conducted at the Imperial College of Tropical Agriculture, Trinidad, showed that cane tops had a digestible crude protein content of 0·6 per cent. and starch equivalent of 11 to 14. The quantity of sugar cane tops available in Ceylon at present is small.

Mango seed kernel.—The kernels are rich mainly in carbohydrates and may be compared with acorns. It was found that over 75 per cent. of the kernels received were attacked by weevils. The better varieties seem to be more susceptible. With regard to the availability of this material, unless and until a mango canning industry is established the collection and transport of the seed will not be economic.

Ingasaman pods.—This material has a fair amount of protein but the collection and distribution may not prove economic.

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TABLE I

Analysis of Indigenous Livestock Feeding Stuff.

	Moisture. %	Protein. %	Carbo-hydrate. %	Ether Extract. %	Fibre. %	Mineral Matter. %	Calorific Value Per 100 gm.
1. Cassava (Manioc) fresh	67·83	0·81	29·63	0·58	0·71	0·44	127· 0
Cassava sundried or desiccated	12·90	2·18	80·24	1·58	1·91	1·19	343· 9
2. Jak ripe (Waraka)	68· 8	1·81	27·54	0·29	0·65	0·91	120· 0
Jak half ripe (Kos)	67·83	2·33	27·76	0·12	0·91	1·06	121· 4
Jak half ripe (sundried) (Calculated)	12·58	5·77	76·50	0·30	2·23	2·62	331· 8
Jak half ripe flaked (pulp and seed boiled and sundried)	12·96	6·48	74·96	0·40	3·16	2·04	329· 4
Jak tender (polos)	86·45	1·78	8·89	0·47	1·65	0·76	46· 9
Jak waste matter (without pulp and seed) fresh	89·12	0·62	7·83	0·12	2·12	0·19	34· 9
Jak waste matter (without pulp and seed) dried	5·29	5·42	68·20	1·00	18·40	1·69	303· 5
3. Breadfruit ripe mature edible	73·70	1·94	21·95	0·51	1·11	0·79	100· 0
Breadfruit ripe mature boiled and dried (whole fruit)	7·68	4·22	71·87	0·89	12·45	2·89	312· 4
Breadfruit ripe mature boiled and dried (edible portion)	8·46	4·20	78·27	0·20	6·73	2·13	331· 7
Breadfruit ripe immature fallen	61·00	2·20	33·13	0·15	1·89	1·63	142· 7
4. Plantain cabbage (undifferentiated core of stem)	95·00	0·21	3·93	0·03	0·74	0·09	16·18
5. Red Pumpkin (tender leaves)	88·90	2·29	5·21	0·13	1·60	1·87	8· 7
6. Fodder grass. Saccharum arnudinaceum young shoots 6-8 months	83·00	1·90	9·50	—	5·03	0·57	45·60
Fodder grass. Saccharum old shoots 2 years	65· 7	1·16	22·48	—	10·33	0·39	94·56
Fodder grass. Saccharum spontaneum 6 months	63·17	1·80	17·82	—	15·07	2·14	78·48
Fodder grass. Saccharum spontaneum 1½ years	58·25	0·89	22·22	—	17·21	1·43	92·44
7. Sugar cane tops (local)	77·20	1·49	13·12	—	6·23	1·96	58·44
8. Mango seed kernel parrot variety	58·79	2·98	37·20	0·55	—	1·03	160· 7
Mango seed kernel Jaffna variety	42·88	3·98	51·93	—	—	1·21	223· 6
9. Ingasaman (Rain tree) Pods without seed	39· 0	6·82	38·92	0·92	12·72	1·62	191·24

SYSTEMS OF MATING IN POULTRY

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INFERTILE eggs, among eggs kept for hatching are a constant source of loss to the poultry farmer. A loss, in that much incubator space is lost when the farmer is in urgent need of chicks and his reputation, as a producer of good hatching eggs, is at stake. There is no doubt that the different systems of mating, which are a very important factor in the production of the maximum number of fertile eggs, need investigation first and foremost. The writer in this article describes and discusses briefly the different systems of mating.

Pen mating is the commonest type of mating adopted in systematic poultry rearing and consists of allowing one cock to mate freely with a given number of hens, the number of hens to one cock depending on the breed. In the case of the heavier breeds like the Rhode Island Red six to eight hens and the lighter breeds like the Leghorn ten to twelve hens. The chief advantage in this system is that both parents of the off-spring are known, if trap nesting is adopted. The disadvantages are threefold. First, many small runs and night houses are necessary, which will appreciably increase costs. Secondly, cocks like most animals have a weakness for particular females, so that some hens may be mated too many times a day while some may be altogether neglected. This is a definite waste of sperm. Thirdly, and most important is the fact that all cocks are not equally fertile and this is the main cause in instances of low fertility in pen mating. Very often cocks, though young are very poor in reproductive capacity and should not be used. This has been found to be the case at the Central Agricultural Station, Labuduwa. Better fertility results can be obtained from the poorer cocks by either reducing the number of hens or stud mating a very limited number, even as low as one hen per day. One improvement in pen mating is to allow the cock to run with the hens for periods of ten days at a time and rest him for alternate periods of one week.

Mass mating is similar to pen mating in that cocks and hens are allowed to run together but the difference lies in that many cocks are allowed to run with the hens, the number of cocks to hens again depending on the breed, as in pen mating. The great advantage in this method is that a large number of fertile eggs are produced at a low cost. A large run and one large house can be used for all the birds. This method too has been tried at the Central Agricultural Station, Labuduwa, and has given very good results. As in pen mating the disadvantage is that some hens may be mated too many times. But the chances of some hens being altogether neglected are very much less because many cocks are used. The fear that a cock of poor

reproductive capacity is used is also allayed to a great extent for the same reason. The only serious disadvantage is that only the maternal parentage will be known if trap nesting is adopted. Here too, as in pen mating an improvement can be effected by resting the cocks for definite periods or by even having two sets of cocks to be used alternatively.

Stud mating as such is not practised in Ceylon. It has been systematically tried out at the Central Agricultural Station, Labuduwa, and proved to be well worth the while investigating further. Stud mating is the mating of a selected cock with a number of hens the cock being housed separately and the hen taken to the cock once in eight to ten days. The optimum number of matings per cock per day and what intervals need careful investigation. Judging from preliminary trials carried out at Labuduwa, the writer is of opinion that one cock should not be given more than five hens per day, three at regular intervals between 6.30 A.M. and 11.30 A.M. and two between 3.00 P.M. and 6.00 P.M. In nature it will be noticed that mating during mid-day seldom occurs, so that these hours should be avoided. The best and most convenient method of stud mating consists in taking the hen to the cock after she has laid her egg and when she can be easily taken from the trap nest itself. In practice it has been found that it is just after the hen has laid her egg that she favours copulation. It has been found to be so in the case of free mating too. The principle underlying this system of mating is the fact that the cock's sperm lives in the cloaca of a female for a period of ten to fourteen days after mating. The safer limit of eight to ten days is taken to ensure fertility. The chief advantage in this system is that an outstanding and valuable male can be mated to a large number of hens in the shortest possible time and the useful period of the cock's life can be appreciably prolonged by controlled mating. Hence this should be a valuable method in breeding and improving poultry in Ceylon. As in pen mating both parents of the off-spring will be known if trap nesting is adopted and as in mass mating a large number of birds, only hens of course, can be housed together in a large run. In short, all the advantages of the other systems are present in this one and proves itself to be superior because their chief disadvantages are absent. Needless to say, this being an artificial system the human factor will play an important part in its success or failure. The individuals personally attending to the mating should be reliable, otherwise results are bound to be poor through carelessness or irresponsibility. This is an all important consideration.

FOOD PREPARATIONS

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BREAD

WHEAT flour is most suitable for bread as it contains gluten, which entraps gases, stretches as these expand and so causes the dough to rise. The flour is tested for its gluten content by making a small quantity (a tablespoonful) into a paste in water and washing away the starch through a small piece of muslin. An elastic mass of gluten remains. If sufficient gluten is not present to form an elastic mass the flour is not suitable for bread making.

The flour is sifted to remove foreign matter and well kneaded to form a dough that does not stick. Water is generally used for kneading. A teaspoonful of brown sugar and half a teaspoonful of powdered salt are added for every pound of flour. A tablespoonful of " potato yeast " or of " yeast sponge " or half a teaspoonful of dried baker's yeast is mixed with the dough to cause it to leaven. The dough is placed in a warm place and covered with a wet muslin cloth to prevent drying. It generally takes about 3 to 6 hours to rise to about twice its normal bulk. The general practice is to prepare the dough in the evening and leave it overnight to rise. The dough is then kneaded down lightly with some edible fat in the proportion of one ounce of it to every pound of flour used. The fat improves the flavour and texture. The dough is then turned into the required shape and placed in a greased bread pan and again allowed to rise for one or two hours. The bread is then baked in a hot oven (350–400°F.) for about 45 minutes, depending on the size of the loaf. The characteristics of good bread are as follows :—

(1) The crust should be a uniform golden brown on the top and a lighter brown on the sides and bottom. (2) The crumb should be soft and velvetty, not soggy, dry or crumbly. (3) Bread of good texture should have small thin walled cells of uniform size and should rebound when pressed. (4) It should have a nutty aroma and be free from sourness.

Much of the success in bread making depends on the quality of the yeast used. " Potato yeast " is prepared by boiling half a pound of potatoes, removing the skins and washing the product. To this is added one ounce of brown sugar, one ounce of wheat flour and half a teaspoonful of salt. These are well mixed to form a stiff dough. To this is added one pint of a boiling extract of " hops " in water. A teaspoonful of " hops " for every pint of water is recommended. The extract should be strained through muslin before addition. The mixture is well stirred and allowed to cool. To this is added a teaspoonful of good baker's yeast. " Potato yeast " prepared in this manner is allowed to rise for about twelve hours before it is used. This product can be kept for about one week in a cool place. The presence of " hop " extract retards the growth of undesirable bacteria, which cause sour taste and off flavours.

"Yeast sponge" is prepared by making a cream with one tablespoonful of flour, half a teaspoonful of brown sugar and boiled and cooled water. To this is added a pinch of dried baker's yeast. The mixture is well stirred and allowed to rise for three to six hours. "Yeast sponge" should be prepared for immediate use. It does not keep well.

BISCUITS

Biscuits can be prepared from almost any kind of flour. Wheat, maize, kurakkan and manioc flour are quite suitable for biscuits. The other essential ingredients are water and fat. Sugar, salt, eggs, milk, ginger and baking powder are added to improve the taste, consistency and nutritive value of biscuits. The flour is sifted and then gently roasted in an open pan with constant stirring for about five to ten minutes. To one pound of flour is added well beaten egg, three ounces of sugar and two ounces of edible fat. To this is added half a teaspoonful of salt and sufficient water or milk to form a soft dough on kneading. Lastly, a teaspoonful of baking powder is mixed with the dough. The dough is rolled out to a thickness of about quarter of an inch or less, according to the type of biscuit required. This can be conveniently done on a pastry board by means of a wooden rolling pin. The biscuits are then stamped out by means of a cutter to the required shapes. A few holes are made on the biscuits by means of a fork or any pointed instrument. The biscuits are placed on a baking pan and baked in a hot oven (350–400°F.) for about twenty minutes until they are quite crisp. About quarter ounce of dried ginger powder and four ounces of sugar per pound of flour are recommended for ginger biscuits.

BREAKFAST FOODS

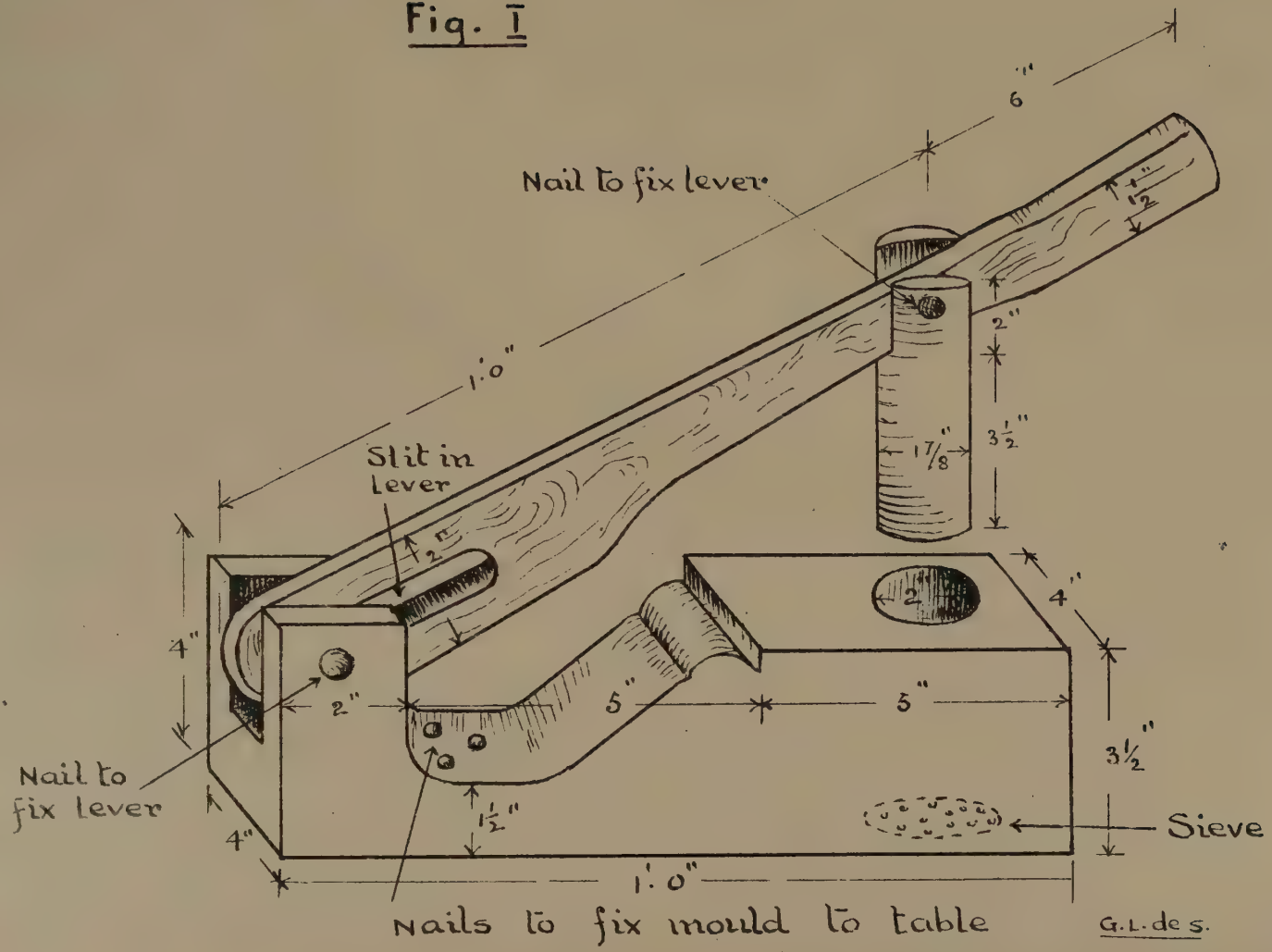
Breakfast foods can be prepared from almost any kind of cereal or millet. While there are many ways of preparing breakfast foods, the most convenient and satisfactory method is to mix the flour in boiling water to form a soft dough. Salt is added at the rate of half a teaspoonful for every pound of flour. The dough is then pressed through a stringhopper mould on to baking pans in thin layers. The product is then baked in a hot oven (350–400°F.) for about twenty minutes until quite crisp. The material is finally broken up into particles of suitable size, as desired. A sketch of a suitable stringhopper mould is shown in Fig. I.

This stringhopper mould can be fixed to the table and operated by means of a lever, as shown in the diagram. The material that passes through the sieve fixed at the bottom of the mould in the usual manner, can be collected by holding the receptacle below.

MEAT SUBSTITUTES

The protein in legumes and pulses (*e.g.*, dhal, green gram, black gram, soya-bean and cowpea) can be suitably treated so as to appear like meat, when cooked. The seeds are soaked overnight in water and the skin rubbed off. The decorticated seeds are then ground into a thin paste and treated

Fig. I



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with salt to taste. The material is then steamed on a piece of muslin cloth tied to a vessel containing water. The vessel is heated to cause the water to boil and the steam is retained by covering the mouth of the vessel with another vessel. The material becomes quite hard after steaming till it is well cooked for about half an hour. The hard mass is then cut into small pieces and fried in oil. The product can then be cooked like meat. The product can also be dried instead of frying and kept for a considerable period. It can be soaked in water and then fried and cooked as before.

MALTED GRAINS

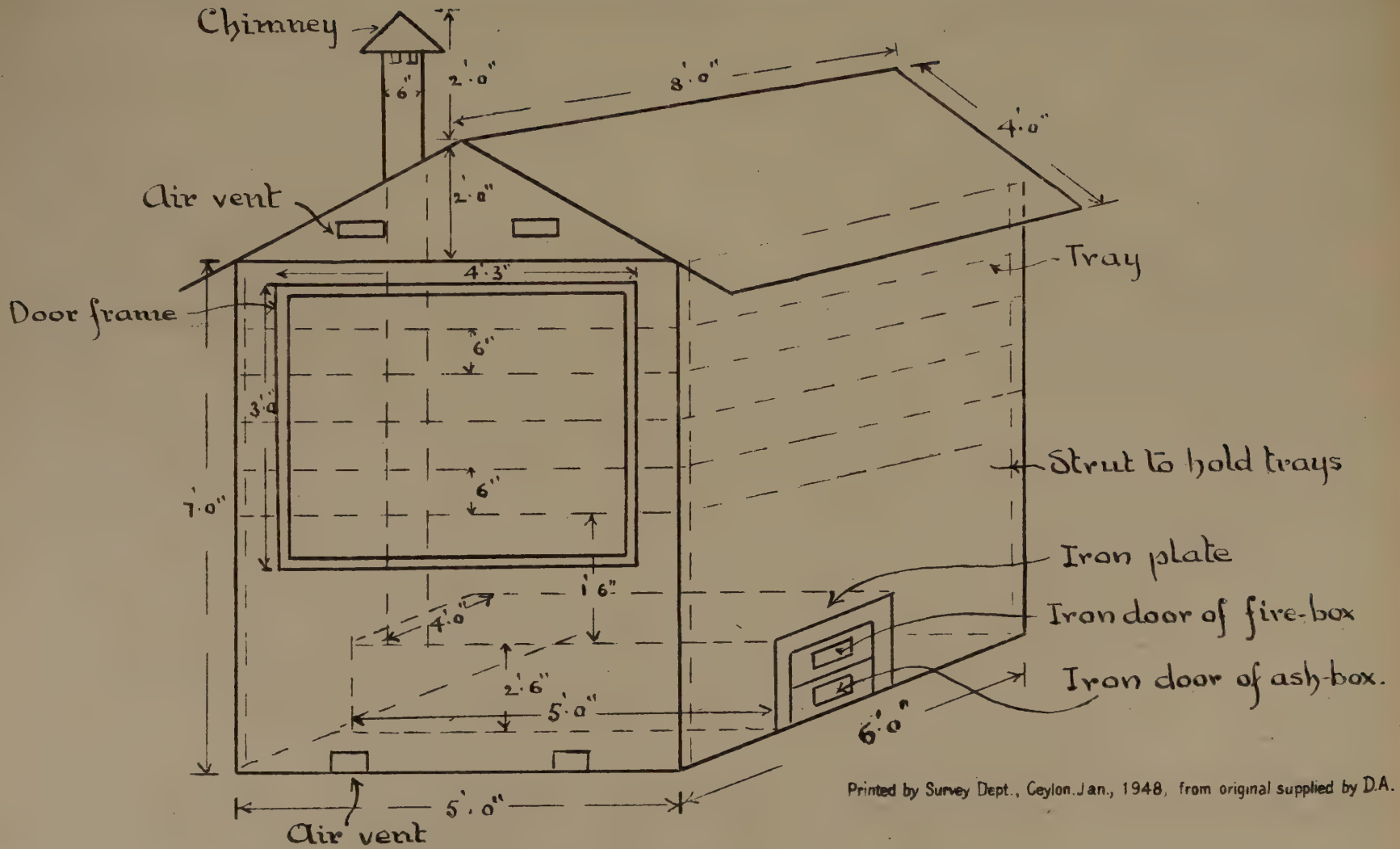
Grains like kurakkan, sorghum and maize can be easily malted by allowing them to sprout till the radicals are about twice the size of the grain. This is done by washing the grains in several changes (five changes) of water to aerate them and then soaking them for about three hours in a weak solution of lime water. The lime water is prepared by adding an excess of well burnt lime to water and after stirring, the insoluble excess of lime is allowed to sediment for about an hour. The clear solution is taken and diluted ten times. The grains are allowed to sprout after soaking in lime water, by spreading them out and covering them with a wet cloth or jute hessian. Water is sprinkled every 12 hours for three to four days until the sprouts are about twice the size of the grains. The sprouted grains are then spread out in the shade to wilt for 12 hours. They are then dried in the sun or in a drier. The sprouts and the husk are removed by gentle pounding and winnowing. The dehusked grains are roasted gently in an open pan with constant stirring until they develop a malted flavour. The malted grains are then pounded or ground into flour. This flour is more nutritious than the ordinary flour as it contains malt which is good for invalids when prepared in the form of a gruel with milk.

DEHYDRATED VEGETABLES

Vegetables lose much of their taste and nutritive value by haphazard methods of drying. Sundrying is generally not suitable in places where wet weather prevails. Moreover, the material to be dried is exposed unduly to dust and other forms of contamination. The only alternative to this is to dry vegetables in a suitably-constructed drier. A simple drier for this purpose consists of a dehydration chamber made of bricks and is 6 ft. long, 5 ft. broad and 7 ft. high at the sides. The roof is made of corrugated galvanized iron sheets. The single door is 4 ft. 3 in. by 3 ft. On each of the two side walls are fitted wooden struts over which five bamboo slat bottomed trays can be stacked in layers in a staggered form. The drier is heated by means of a fire box to which is fitted an iron plate one eighth of an inch thick with a layer of sand half to one inch thick on the top, to radiate the heat evenly into the drying chamber. A brick chimney is connected to the fire-box to provide an outlet for the smoke. Two air vents are provided at the base of the front and back walls and two vents each are provided at the

top as well. These air vents are provided with adjustable panels to control the passage of air in and out of the drier. A sketch of the drier is shown in Fig. II.

The vegetables are sliced and immediately placed in a weak solution of salt ($\frac{1}{8}$ lb. of salt per gallon of water). They are then blanched in boiling water for about 3 to 5 minutes. By this treatment the vegetables are prevented from undergoing discolouration on drying. The blanched vegetables are allowed to drain free of water and then spread out in thin layers on to the bamboo slats and dried at 70° C. to 50° C. for four to six hours to a moisture content of about 8 per cent. to 10 per cent. The temperature inside the drier could be determined by suspending a thermometer. The temperature can be controlled by adjusting the air vents and the rate of firing.



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VACCINATION AGAINST RANIKHET DISEASE

BY

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DURING the last three years we have been exploring different methods of preparing Ranikhet disease vaccine, and the results are surveyed in the present paper. As will be seen, more than one of these efforts quickly gave very encouraging results. These have not yet been investigated exhaustively, because at the time other methods appeared to be still more promising and because the urgent need of the moment was a vaccine which would help to stem severe losses from Ranikhet disease and so assist the country's war effort. In due course, it will be profitable to re-examine some of the procedures in order to come to a more firm decision as to the vaccine that should be finally recommended.

Strains of virus used.—R 1, a virulent laboratory strain kept in fowls, R 10, a freshly solated field istrain kept in egg culture, and R 2, attenuated egg-passaged virus, were used.

1. GEL-ADSORBED VACCINE

In a preliminary report (Haddow and Idnani, 1941) an account was given of the preparation of a vaccine by adsorbing virus from a spleen pulp emulsion on an aluminium gel. We have since made modifications which have given better results. In the first place, since different brews of gel, prepared by the method previously described, did not give constant results, we adopted the following technique, mainly according to Willstatter, Kraut and Erabacher (1925).

One hundred c.c. of 10 per cent. ammonia solution (accurately prepared) were poured into 600 c.c. of water at 63° C. containing 22 gm. of ammonium sulphate and the temperature was quickly brought to 58° C. The solution was stirred vigorously, and 150 c.c. of water at 58° C. containing 76·7 gm. of ammonium alum (Baker Chemical Co.) were poured in rapidly as one lot. The mixture was shaken in a stoppered bottle for 15 minutes at 60° C., care being taken to keep the temperature constant during the process. It was then transferred to a tall jar and was washed each time with about five litres of distilled water by decantation and not by certrifugation. At the fourth washing, 80 c.c. of 20 per cent. ammonia solution were added to the wash water, before it was used. The washings were repeated about 20 times, until the supernatant fluid no longer became clear. The last two or three washings occupied several days. The final suspension of 1,000 c.c. was left at room temperature for at least two months before use.

Vaccine prepared from such gels have not varied greatly. It appeared, however, that the spleen emulsion introduced a very variable factor into the manufacturing process, and it was, therefore, decided to use instead of spleen allanto-amniotic fluid from hens' eggs, the fluid being collected 48 hours after the inoculation of 9 or 10 day embryo. This fluid has a more constant virus content and is much cleaner to work with. Using this method, the following experiments were tried ; (1) diluting the virus before absorption ;

dilutions even at 1/10, however, greatly reduced the immunizing capacity; (2) using eluates of prepared vaccine—these also were unsatisfactory; (3) reducing the concentration of formalin,—but concentrations below 1/2,000 were not safe; (4) reducing the incubation period but using formalin at 1/2,000 periods below 24 hours were not always safe; and (5) reducing the dose of vaccine,—0·5 c.c. to 1·0 c.c. is satisfactory for adult birds, young chickens can be immunized satisfactorily with 0·2 c.c. Table I is an example of some experiments on these lines.

Extracted from Indian Journal of Vet. Sc. Vol. XVI, Pt. II, pp. 45 et Seq.

TABLE I

Vaccination with gel vaccine

	Date. 1943.	Type of Vaccine.	Dose (c.c.).	No. of Fowls.	Result of Test ten days later.
1.	December 1	Fresh vaccine	1·0	3	S
	Do.	do.	0·2	3	S
2.	Do.	Incubated at 37° C.	1·0	3	S
	Do.	do.	0·2	3	1 D
3.	December 2	Eluates from above	1·0	6	3 D
	Do.	do.	1·0	6	5 D
4.	December 4	As 1, then stored 3 days in ice	1·0	3	S
	Do.	do.	0·2	3	1 D

N.B.—In all experiments given in this and later Tables virus controls were used and all died without exception.

S = Survived; D = Died.

The period at which complete immunity is established appears to be not less than seven days. Tests at shorter intervals gave variable results.

Small scale field experiments were carried out and the results are shown in Table II. In the case of birds vaccinated on December 28 and January 13, the vaccine was transported some 90 miles in two days and during the time was kept on ice; in the other cases it was made on the spot.

TABLE II

Vaccination with gel vaccine

Date. 1943.	Dose of Vaccine (c.c.).	No. and Age of Fowls.	Tested on Day.	No.	Tested and Result.
December 28	1·0	21 adults	130	8	S
Do.	0·2	10 one-day old chickens	17	2	S
			94	2	S
			115	3	S
			187	3	D
December 30	0·2	5 one-day old chickens	105	2	D
			113	3	1 D
	0·2	6 three-day old chickens	113	6	S
1944 January	0·2	8 five-day old chickens	13	4	S
			90	4	S
	0·2	10 one-day old chickens	13	4	S
			103	4	2 D
January 13	1·0	24 adults *	32–40	10	S
			171	3	2 D
January 23	0·2	75 two-day old chickens	91	6	3 D
			104	18	2 D
Do.	0·2	3 adults	89	3	S
May 26	1·0	40 adults	115	6	2 D

* Eight fowls in contact developed no immunity.

From Table II it will be observed that all adult fowls vaccinated proved to be solidly immune for five months. In tests at longer intervals the immunity appeared to be waning. In chicks, the period of complete immunity was two to three months after which the results were variable.

At this point in the work it became evident that other methods of vaccination, referred to below, were likely to be more immediately profitable, hence this particular line of work was dropped. It may be said, however, that the advantages of the gel vaccine are that it can be applied safely to fowls or chicks without interference with health or reduction of egg-laying ; on the other hand, the gel is troublesome to prepare and, since it does not keep well, its use, particularly in India, must obviously be limited to organized poultry farms adjacent to well-equipped laboratories.

II A. PIGEON PASSAGED VIRUS

Various workers have commented on the fact that pigeons can be infected with Ranikhet disease, but attempts to carry on the virus in this species have failed after three or four passages.

One of us (J. R. H.) had carried out experiments earlier in collaboration with Iyer (unpublished), and from one of these, it appeared that further passages, though uncertain, might be more successful than was previously thought possible. We have now examined further the possibility of fixing the virus in pigeons. The previous failures may perhaps be attributed to a low virus content in pigeons dying in earlier passage before the virus is fixed, and also to the use of adult pigeons. Hence, we used material from young, 4 to 5 months old, pigeons destroyed just after the height of febrile reaction, and, as an added precaution we inoculated eggs from each pigeon passage in order to secure large quantities of virus.

The first attempt, using strain R1, failed at the second passage, but a second attempt, using strain R10, was successful. The virus recovered from the first passage was passaged twice in eggs and thence directly in pigeons until the ninth passage when it died out. Revived with egg-passaged material from the seventh pigeon passage, it was again successfully continued by direct passage. Up to about the twentieth passage, reactions in pigeons were late (6 to 9 days) and a number survived or were rapidly improving at the time of destruction. From the twentieth passage onwards the virus appeared to be fixed, the reaction appearing in 3 to 5 days and being in all cases severe and invariably fatal. Periodic test results are given in Table III.

TABLE III

Inoculations with pigeon-passaged virus.

Passages.	No. of Fowls.	Result.
11–50	22	3 died, 6 reacted and recovered, 7 no reaction—immune
51–100	32	3 died, 3 reacted and recovered, 26 no reaction—immune
	6 (chicks)	1 died, 3 reacted and recovered, 2 no reaction—immune
101–180	135	11 died, 25 reacted and recovered, 99 no reaction—immune
	47 (chicks)	21 died, 3 reacted and recovered, 23 no reaction—immune

As only small numbers of fowls were inoculated in the first two groups of passages, the results are not reliable enough to permit drawing firm conclusions. In the third group, however, several batches, each of 25 birds, were inoculated, and the results in these cases give a clear indication of the degradation in virulence which has occurred during many pigeon passages. Contrary to out observations on viruses degraded in other ways, it was noted that as virulence decreased, the incubation period grew longer. Ultimately, the incubation period had extended from the normal 3 or 4 days to 7 to 9 days, and, as might be anticipated, the immunity conferred is more slowly achieved, viz., after 4 to 5 days as compared with 48 hours with other strains. The total losses incurred in using pigeon virus as a vaccine amount to 12 to 16 per cent. of birds inoculated, *i.e.*, 8 per cent. mortality plus 4 to 8 per cent. of reactors permanently maimed. The pigeon virus is not suitable for vaccinating chicks.

Work with this strain is being pursued owing to the advantage that the pigeon virus could be transported in the living bird and no refrigeration would be necessary as is the case with other vaccines. In one experiment, healthy fowls were kept in contact with vaccinated fowls and with pigeons. The contact birds did not contract infection and they were later found to be fully susceptible. Hence, it seems there would be no danger in transporting the virus in living pigeons.

II B. DUCKLING PASSAGED VIRUS

One of us (J. A. I.) had previously found that Ranikhet virus could be readily transplanted into duck embryos, and it appeared possible that, as adult ducks are known to be resistant, continued passage of the virus in duck eggs might alter its virulence for fowls. To this end, 50 passages in duck eggs were accomplished; at the tenth passage, the virus was slightly attenuated for fowls, but continued passage produced no further noticeable attenuation, and as there was no indication that attenuation produced in this way differed from that obtained in hen's eggs, the experiment was discontinued. It was then considered that passage in very young ducklings might be more effective. Three separate attempts were made with ducklings one to ten days old, two with viruses already frequently passaged in duck eggs—which were as noted slightly attenuated for fowls—and one with the stock R1 strain. These attempts gave more or less similar results. Firstly it was found that though such ducklings react not all of them die, and, if passage is to be successful, it is necessary to destroy them as soon as they show symptoms. It is also advisable to sub-inoculate on eggs in order to obtain greater quantities of virus. In all three attempts we were unable to go beyond the fifth duckling passage, at which stage the virus had become markedly attenuated for fowls and also grew very slowly in embryos which survived for 3 to 7 days. In the latter case, normal growth and embryo-killing powers were recovered after two or three hen's egg passages, but the virulence for fowls did not return. One of these strains was then maintained in hens' eggs, and Table IV shows its vaccinating properties.

TABLE IV

Vaccination with duckling-passaged virus

	No. of Fowls Vaccinated.	Result of Test on the 14th day.	
Laboratory experiment	56 ..	No reaction ..	Immune
	40 (chicks) ..	do. ..	18 immune, others not tested
First Field Trial	782 ..	48 died, 3 paralysed ..	Loss 6·5 per cent. *
Second Field Trial	2,023 ..	15 died, 3 paralysed ..	Loss 0·9 per cent.
Third Field Trial	1,000 ..	22 died, or paralysed ..	Loss 2·2 per cent.
Fourth Field Trial	1,474 ..	46 died, or paralysed ..	Loss 3·1 per cent.

* First trial complicated by fowl cholera.

It will be observed that this strain makes an excellent vaccine and it has the advantage over the egg-passage vaccine that the method of attenuation is fairly precise and can be repeated as far as we know at will. Chickens can apparently be vaccinated safely, although the numbers that have been done are not yet large enough to give an adequate picture of its effects in these young birds. Healthy birds in contact with birds undergoing vaccination may contract infection,—of five healthy fowls in contact with 25 vaccinated fowls, one was immune and the infection conveyed was " silent " in nature.

EGG PASSAGED VIRUS

Iyer and Dobson (1940) and Iyer (1941) reported that they had obtained an avirulent strain of Newcastle disease by passaging the virus serially through developing fowl embryos. Attenuation apparently occurred somewhat suddenly about the 14th and 33rd passages in the two attempts reported. Iyer (in the press) has described further work on Indian strains, in which attenuation by simple egg passage was either unsuccessful (two trials) or only partially so (one trial). In the partially successful experiment, a semi-attenuated strain appeared after 19 passages and again apparently somewhat suddenly. Subsequent passage produced no further change and the strain then appeared to be fixed at a point where 40 to 50 per cent. of birds inoculated either died or were permanently injured. Various factors which may have led to this attenuation in the egg are mentioned by Iyer and Dobson (1940), and, when circumstances necessitated our taking over the work, we attempted to see how far these factors were operative and if possible to define the process of attenuation more precisely. Unfortunately, owing to war requirements our efforts had to be hastened and so were confined to lines which seemed to promise quick results.

To begin with, it was necessary to organize a continuous supply of satisfactory embryos and fully susceptible fowls, previous work at the Institute having been vitiated by lack of these. Local difficulties in incubation and in transporting eggs from the Poultry Research Section at Izatnagar, 90 miles away also had to be overcome. Unless otherwise stated, amniotic fluid was used in all cases for transmission work, since this has a fairly constant virus content (m. l d. for fowls, 1×10^6) and can be collected easily without risk of contamination. It is convenient to use 0·1 c.c. of the undiluted fluid as inoculum in passage experiments, and this dose kills the embryo within 42 hours. Lower dilutions kill embryos more slowly and at 1×10^7

to 1×10^9 death may be delayed until the third or fourth day after inoculation. Deaths at longer intervals with virulent virus have not been noted, but deaths after five to eight days have occurred with viruses altered by artificial means and in these cases there is often a very noticeable œdema of the embryo's skin.

OPTIMALINTERVAL FOR PASSAGE IN EGGS

Eggs were incubated for three, four and seven days after inoculating virus and serial passages were made at those times. As these eggs invariably became contaminated with moulds or bacteria, the three and four day series were stopped after the sixth and fifth passages respectively, at which time there was no evidence of attenuation. The seven-day series was continued for 12 passages, by which time the virus had died out. It was evident from intervening tests that the virus content of eggs decreased when the period of incubation in each passage exceeded three days. In a parallel experiment in which the amniotic fluid was kept in test-tubes in the incubator between each passage the virus died out at the fifth passage.

The effect of passaging at short intervals has also been tested ; for this, 24 hours was selected as suitable. The strain of virus, R1, selected for this purpose, was one which had already been passaged 65 times at two-day intervals without undergoing any change, (Iyer, 1941). This strain was freshly isolated from fowls and then passaged regularly at the shorter intervals. Table V gives the results.

TABLE V

Tests with 24-hour passaged egg virus

No. Passage.	No. of Fowls used.	Results.
50	2	Severe R ; recovered
60	2	D
132	2	R ; recovered
155	4	D
188	4	R ; 1 D
	2 sub-inoculated from dead bird of passage 188	R nil ; I
203	5 (various dilutions)	Slt R ; I
203	3 (chicks)	Severe R ; 1 D
	2 sub-inoculated from dead chick	R nil ; I
	6	3 R ; 1 D
	2 sub-inoculated from dead fowl	R nil ; I
203	6	R nil ; 51 (1 D before test)
	7 in contact with above	2 R ; 7 I
240	8 (various dilutions)	3 D ; 5 I
	2 sub-inoculated with liver of dead bird	1 R ; both I
259	3 (chicks)	2 D
264	4	4 R ; 1 destroyed
	2 sub-inoculated from destroyed fowl	R ; I
302	8 (various dilutions)	2 D
330	2	D
333	4 (chicks)	D

R = reacted. I = immune. D = died.

It will be observed from Table V that during the first fifty passages the virulence was partially lost ; the change being more or less comparable

to that obtained by Iyer with his line II (our R2). Further passage produced no marked loss of virulence, and what originally appeared to be a hopeful line of advance was abandoned after over 300 passages.

The net result of the work done under this heading was that eggs were incubated after inoculation for 48 hours as a routine and the virus then collected.

INCUBATION OF EGGS AT 41·5° C

Incubating the eggs at 41·5° C was ttied but at the 15th passage the virus was still fully virulent.

HEATING OF THE VIRUS

The effect of heating the virus was examined. The virus to a final dilution of 1 : 10 and 1 : 50 was added to water raised to the temperature required. From these experiments no results of practical importance emerged, but it was noted that at all temperatures tried the virus remained alive much longer than previously reported. Thus, at 55° C the virus was still viable after three hours, at 60° C after one hour, and at 70° C after 15 minutes. At 60° C the virus after $1\frac{1}{4}$ to $1\frac{3}{4}$ hours' heating appeared to undergo a change. When inoculated into eggs the embryos died in three to seven days with typical lesions of Ranikhet disease and usually also with marked skin œdema. There were also a few faint follicular lesions. Sub-inoculation into fowls either from first or second passage from such embryos produced no reaction or immunity. That the virus was not dead was shown by the fact that direct inoculation of the heated material into chickens and fowls gave results varying from acute affection, solid immunity without reaction, to no reaction and no subsequent immunity.

GEL VIRUS AS SEED MATERIAL

It appeared from the results of the gel vaccines that it might be possible to recover virus in an altered form at some stage in its production. Several attempts were made and the results often conformed with those obtained during the heated virus experiments just mentioned, *i.e.*, embryos were obtained showing typical lesions from which sub-inoculations in eggs were negative or only weakly positive. In no case could the infection be transferred from these embryos to adult fowls.

In one instance a strain comparable to those found in the heated virus and gel virus experiments was isolated from drinking water from an infested pen. No exhaustive investigation was made, but the occurrence of such strains may perhaps be a factor in the preservation of the few birds which survive during a natural outbreak.

MIXTURE OF VIRUS AND SERUM, &c.

Small-scale experiments were carried out at incubator temperatures with mixtures of virus and antiserum, virus and bile, virus and crystal violet, and virus and glycerol. With the first three, the indication was that viruses were produced which behaved somewhat like those of the gel and heated viruses. When mixtures of virus and glycerol were inoculated on to embryos, virus could not be re-isolated.

TESTING OF FIELD STRAINS BY EGG PASSAGE

Iyer (Loc. cit.) has suggested that strains from different outbreaks might vary in behaviour during egg passage. To examine this point, eight strains were passaged at about monthly intervals, whenever eggs were available. After about 30 passages there was no change. The matter, however, is not regular. Thus with strain R1, which on account of its high virulence has been maintained as our stock strain in fowls, it was found in one instance that some loss of virulence had occurred from as few as three egg passages. In another trial, the same strain was passaged 54 times without visible change. For this, no satisfactory explanation can be offered. The possibility that attenuation may have been due to contaminating bacteria or fungi was examined with entirely negative results. In one case it appeared that eggs from freshly vaccinated fowls might have been a factor.

In addition to the strains mentioned above, we maintained three sub-lines of Iyer's line II, designated R2B, R2C and R2D. Iyer (in the press) has reported the results of a fairly large test of the 92nd egg passage of R2B, in which the casualty rate was about 45 per cent. or over. These strains were again tested by us at the 114th, 103rd, and 87th passages respectively, using two fowls each time. In the case of R2B, both fowls reacted slightly and recovered, with R2C the reaction was more severe and one died, and in the case of R2D both fowls died. Larger experiments were then initiated with passages 115 to 126 of R2B and these gave uniformly good results without casualties. The experiments covered over 100 adult birds. In addition, it was shown that, while birds undergoing vaccination were infective to healthy in contacts, such infection, was " silent ". As expected, the number of healthy birds infected varied with the ratio of vaccinated : healthy, *e.g.*, in one experiment where the ratio was 1 : 1 (ten birds in each group), only two healthy birds were later found to be immune. In another experiment where the ratio was 4 : 1 (16 vaccinated fowls), all four healthy were silently immunized. Chickens were also vaccinated and it was found that those under ten days old reacted violently with an occasional death and a high percentage permanently maimed. From ten days to a month the death rate rapidly diminishes but the proportion of paralysis cases remains rather high. After one month vaccination can be satisfactorily applied and the casualty rates are nearly comparable to those in adult fowls, provided there is not intercurrent coccidial infection.

FIELD TRIALS

Frequent titrations of the amniotic fluid in fowls and chicks have shown that an immunizing dose was contained in a 1×10^{-6} dilution. Also the virus dies rapidly when diluted or if exposed to heat. It was, therefore, considered expedient to carry out the first field trials using virus stored on ice and freshly diluted at 1/1,000 at the time of inoculation. The dose given was 0·5 c.c. The results of the first field inoculation, which was carried out on the poultry farm at Izatnagar, are recorded in Table VI, 1,492 birds, mostly pullets, were vaccinated, and control pens were kept to study the effect on growth and egg laying. The breeds included Rhode Island Reds, White Leghorns, local Indian, and crosses of these breeds.

TABLE VI

Field trials with egg-passaged vaccine on 1,942 birds

Days after Vaccination.	Dull.	Comatose or ill.	Lame.	Paralysed.	Destroyed as useless.
1					
2					
3		1			
4	Approx. 50 per cent.	4	3	2	
5	Approx. 75 per cent.	65	8	7	
6	Approx. 75 per cent.	87	10	10	
7	Approx. 75 per cent.	29	18	13	
8	Approx. 50 per cent.	6	27	11	
9		10	23	12	
10		2	30	14	1
11			28	14	
12			32	12	
13			33	11	
14			32	9	
21			22	6	
28					8

The results show that quite a large percentage of them were mopy and about 6 per cent. actually comatose. The symptoms pass off rapidly and usually leave no ill effects. Mild cases of lameness also tend to recover rapidly unless intercurrent coccidial infection is present. The common helminthic infections are not affected, nor do they affect the degree of reaction during vaccination. Except for a few severe cases amounting to 0·5 per cent., all birds had recovered within a month. As in practice it is not convenient or economical to nurse ailing birds for long, we consider that all birds which are definitely lame or paralysed on the 14th day after vaccination should be destroyed for food. This procedure gives a total casualty rate of about 2·5 per cent., a rate which varies within small limits according to breed. In heavy placid birds, *e.g.*, Rhode Islands the rate is lower than in light and more nervous breeds such as White Leghorn or Indian.

Vaccination has no effect on subsequent growth rate either in chicks or pullets, but it markedly interferes with egg-laying. About the sixth or seventh day after vaccination, egg-laying decreases and usually entirely ceases by the tenth day. Birds which have no visible start laying gradually about the 14th day, and full production in all except those seriously affected is resumed after 21 days. A number of not less than 1,000 birds forms a suitable basis for a day's work and for convenience the virus is diluted at 1 : 500. Thus one ampoule of virus provided vaccine for the day. Actually, experiments have shown that there is no noticeable difference in the severity of reaction between an undiluted and a diluted virus. At first, only birds over four months old were vaccinated, but later it was found safe to reduce the age limit to six weeks, at which time the birds usually leave the brooders.

In all, well over 100,000 have been vaccinated and the results of those for which records are available are given in Table VII.

TABLE VII

Vaccination with egg-passaged virus

	No. of Birds.	Casualties *	Percentage.
Where no intercurrent disease was noted ..	61,372 ..	1,971 ..	3·2
Where intercurrent disease or unfavourable conditions existed	22,147 ..	2,962 ..	13·3
Total ..	83,519	4,933	5·9

* Casualties include deaths and culls from all causes during 14 days from the date of vaccination. Figures are thus somewhat higher than those observed when only casualties directly attributed to vaccination are recorded.

The diseases encountered included Ranikhet disease, mild fowl pox coccidiosis, mild fowl cholera, and spirochaetosis. In all cases, where flocks were clean and management was good, results were uniformly good, but where intercurrent disease, other than Ranikhet disease or unfavourable conditions existed, the casualty rate was higher.

Apart from flocks where for various reasons the general standard of management was low, it was observed that dietetic errors gave rise to high casualty rates and that heavy rain or excessive heat during the period of reaction were unfavourable factors. The latter, however, were not of sufficient importance to prevent the prosecution of vaccination during the hot weather and monsoon periods, provided the birds had plenty of space.

When Ranikhet disease is present on the farm, the degree of control obtained is largely dependent, of course, on the time taken for immunity to develop, and by experiment this was shown to be about 48 hours after inoculation. In accordance with this, it is found that in pens already infected, mortality from the disease ceases on the fourth or fifth day after vaccination. As Ranikhet disease spreads rapidly insusceptible fowls, the vaccine must be applied quickly if it is to be effective. In one small flock of 210 birds, distributed in an isolated pen of 32 birds and in three contiguous pens, the results were as follows :—

Isolated pen (32 birds) ..	1 dead and 3 sick at the time of vaccination	18 were protected
Contiguous pens Nos. 1 .. and 2 (107 birds)	3 dead and 23 sick at the time of vaccination	17 do.
Contiguous pen No. 3 (71) birds	None sick	62 do.

Pen No. 3 was vaccinated first, and the high mortality in pens Nos. 1 and 2 is attributed at least in part to the fact that, despite precautions to prevent the spread of infection on instruments during vaccination, infection was spread by contact with the cloth of the operators. Although preventive vaccination has always been our objective, in several outbreaks on large farms where separate attendants are available our results indicate that it is possible to save 70 per cent. of birds in pens in which the disease is not evident, about 50 per cent. in pens in which the disease has clearly just started and only about 10 per cent. in pens where the disease has obtained a firm hold.

We have as yet had no opportunity to test the duration of immunity over the full period of a fowl's normal life. Frequent small-scale tests have

been carried out from eight days to nine months after vaccination and in no case has there been noted any evidence of a breakdown in immunity. Approximately 250 birds, vaccinated at ages between one and seven months, have been tested nine to fifteen months later and all have proved solidly immune. One or two outbreaks of the disease have occurred on farms which possessed vaccinated fowls and in all cases the vaccinated birds resisted infection.

In view of the isolated result obtained by Iyer (1941), in England in which one chicken was proved immune two years later, taken together with the fact that even very young chickens show no diminution in immunity after six months as they do in the case of gel vaccine, it is hoped that a serviceable immunity will persist for the normal life span.

DRIED VIRUS

Undiluted virus may be kept at refrigerator temperatures without noticeable deterioration for three to four months, after which a progressive reduction in virus content occurs but, as the virus in amniotic fluid does not stand exposure to high temperatures for long, it may be completely inert after three days at 37° C.—and as considerable difficulty was experienced in transporting the vaccine on ice, a few experiments have been carried out with virus dried on glucose powder, cotton wool, muslin, and filter paper. Dried yolk, which has a similar virus content to amniotic fluid was also used. Of these, glucose powder and cotton wool were the most successful. However, it is not easy to get uniform suspensions from the cotton wool material, but the glucose is easily handled. The method consisted of dropping 1 c.c. amniotic fluid on to 1 gm. of glucose (or proportionate smaller quantities), and then drying this in a vacuum desiccator over calcium chloride. More than 200 chicks were vaccinated with this material, but neither a standard procedure of its preparation nor the temperature limit at which it may be safely kept have yet been defined.

SUMMARY

1. The results of vaccination with virus absorbed on alumina gel previously described have been amplified. It has been shown that vaccination can be carried out successfully and safely at all ages, but that the immunity conferred is not of long duration and in very young chicks may not exceed two months. Preparation of the vaccine is tedious and the safe time limits for use after preparation restricts the practical application of this vaccine to short range work in areas adjacent to a well-equipped laboratory.

2. By passage of the virus in pigeons a satisfactory vaccine has been evolved.

3. A more rapid reduction in virulence was attained by a few passages of the virus through one to ten-day ducklings.

4. Various factors which may influence the loss of virulence of the virus during passage in hens' eggs have been examined. The virus content of embryos decreases if incubation exceeds three days. Vaccine could not be obtained from viruses heated at 60° C–70° C. The same was true of virus isolated from gel mixtures, virus mixed with immune serum, with bile, crystal violet, or glycerol.

5. Attenuation to various degrees occurred on passage of the virus in hens' and ducks' eggs. The practical application of one such strain, in which the attenuation was maximal, has been described. Over 100,000 birds of all ages over one month have been successfully vaccinated at casualty-rates varying from $2\frac{1}{2}$ to 6 per cent. according to the general standard of health of the birds vaccinated. The vaccine consists of amniotic fluid taken 48 hours after the inoculation of nine or ten day embryos. This is ampouled in 1 c.c. quantities and may be kept at refrigerator temperature for three to four months. It is diluted 1 : 500 with sterile water immediately prior to use and the dose given is 0·5 c.c. subcutaneously. Immunity develops after 48 hours and lasts for more than one year. Birds undergoing vaccination are infective, but the infection that may be so transmitted is "silent".

REPORT OF THE PROCEEDINGS OF THE TWELFTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD AT PERADENIYA IN THE ASSEMBLY HALL OF THE SCHOOL OF AGRICULTURE ON MONDAY, FEBRUARY 24, 1947.

MR. L. J. SENEVIRATNE, C.C.S., Acting Director of Agriculture, presided and the following were present :—Col. T. Y. Wright ; Mr. A. R. Panditesekera ; Mr. Chas A. M. de Silva ; Dr. Reginald Child, Director, Coconut Research Scheme ; Dr. A. W. R. Joachim, Chemist ; Mr. L. B. de Mel ; Mr. P. B. Bandaranayake ; Dr. M. F. Chandraratne, Botanist ; Mr. R. H. Bassett, Commissioner for the Development of Agricultural Marketing ; Mr. T. M. Z. Mahamooth, Deputy Director, Animal Husbandry ; Mr. Wilmot A. Perera ; Mudaliyar N. M. Abulcassim Marakar ; Gate Mudaliyar S. Muttutamby ; Mr. S. Sivapalan ; Mr. B. de Zilva ; Mudaliyar K. Chinnatamby ; T. B. Poholiyadde Dissawa ; A. E. Madawala Dissawa ; Mr. S. L. Bandara Dharmakirti ; Rev. Fr. L. W. Wickremasinghe ; Sir Wilfred de Soysa ; Mr. A. R. T. Gibbon ; Mr. R. H. de Mel ; Mr. H. W. Amarasuriya, M.S.C. ; Dr. W. R. C. Paul, Divisional Agricultural Officer, S.-W. D. ; Sir James P. Obeysekera ; Mr. S. G. Taylor, Director of Irrigation ; and Mr. M. J. Perera, C.C.S., Secretary.

The following visitors were also present :—Mr. P. G. Malkani, Principal, Ceylon Veterinary College ; Mr. S. B. Yatawara, Propaganda Officer and Mr. S. Kandiah, Secretary, Research and Experiments Committee, Department of Agriculture.

Letters and telegrams regretting inability to attend the meeting were received from :—Mr. A. T. Sydney-Smith ; Hon. Mr. Geo. E. de Silva ; Mr. R. Bois ; Mr. R. T. Chelliah ; the Registrar of Co-operative Societies ; Director, Tea Research Institute ; Director, Rubber Research Scheme ; Conservator of Forests ; Mr. Simon Abeywickrama, M.S.C. ; Mr. H. W. M. Jayawardene ; Mr. Spencer-Schrader ; Mr. James P. Fernando ; and Mr. A. G. Ranasingha, Land Commissioner.

I. CONFIRMATION OF THE MINUTES OF THE LAST MEETING.

The minutes of the last meeting held on November 18, 1946, copies of which had been circulated among the members, were confirmed subject to a few amendments required by some members.

II. MATTERS ARISING OUT OF THE MINUTES.

(*a*) Appointment of Irrigation Presidents (*vide* pages 19–21 of printed minutes, November 18, 1946).

Letters received from Government Agents on the subject were tabled.

The following are extracts from the respective letters :—

1. *G. A., S. P.*—" This problem does not arise in the Galle District as no offences under the Irrigation Ordinance are brought before the Rural Courts here."

2. *G. A., Uva.*—" It has been found that trial of Irrigation cases by Rural Courts leads, in certain areas of this Province, to delay in the disposal of the cases. A proposal to have Irrigation Tribunals in such areas is receiving attention. But, it is not proposed to have full-time officers as Presidents of Irrigation Tribunals, as sufficient work is not likely to be available to keep them fully engaged."

3. *G. A., Sabaragamuwa.*—" I agree with the Board's resolution that the system of trial of Irrigation cases by Irrigation Presidents is better than trial by the Presidents of Rural Courts. The latter have not the time nor the experience necessary to deal adequately with such technical matters—matters, which can often be settled best by an inspection in the field.

The best system for the trial of irrigation cases is trial by the G. A., or A. G. A., in person without the assistance of any " Council." I have tried hundreds of such cases in Mullaitivu-Vavuniya, Mannar and other Districts under section 31 of Ordinance No. 45 of 1917. This method is quick, simple and satisfactory.

The next best trial is by an " Irrigation President "—normally a Chief Headman under the old system, *e.g.*, in Trincomalee District—assisted if necessary by three to seven " Councillors." Nowadays in most Districts the President would have to be a D. R. O.

The Batticaloa District should in my opinion be allowed to adopt either of these two systems. This would relieve the Rural Courts of overwork and make the enforcement of the irrigation rules speedier and more efficient."

4. *G. A., N.-C. P.*—" It is not quite clear what hardship is caused to villagers by the present system of " inquiring into offences committed under the Irrigation Ordinance in the Rural Courts." In this Province delays in the disposal of cases causes hardship only to the Vel Vidane, because the recovery of expenses incurred by him in doing the work, which cultivators fail to do, is delayed.

I have found that delay in the disposal of cases instituted by the Vel Vidanes is due largely to a want of diligence in pursuing the cases to a speedy conclusion. The Rural Courts have enough time to deal with these cases and there is in my opinion no necessity at present for the appointment of special officers to try them."

5. *G. A., W. P.*—" There is provision under section 96 of the new Irrigation Ordinance 32 of 1946 for trial of Irrigation offences ' committed in any area declared to be a Special Irrigation Area by order made by the Minister ' under that section to be tried exclusively by Irrigation Tribunals.

So far as the Western Province is concerned I do not consider it necessary to declare this province a Special Area."

6. *G. A., E. P.*—" I have already addressed the Secretary to the Minister of Agriculture and lands on the subject of the proclamation of special areas for which Irrigation Tribunals should be established in this District. I have recommended that such Tribunals should be established in the following areas :—

(1) The D. R. OO. divisions of Manmunai North and Manmunai South and Eruvil Porativu pattus.

(2) The D. R. OO. divisions of Eravur korale and Bintenne pattus.

(3) The D. R. OO. divisions of Karavahu and Nindavur pattus and Sammanturai pattu.

(4) The D. R. OO. divisions of Akkaraipattu and Panama pattu."

7. *G. A., N. P.*—" At present an appointment of an Irrigation President to this District is not necessary but when the Irrigation Ordinance is applied to Manawari lands, it will be necessary to appoint an Irrigation President."

8. *G. A., N.-W. P.*—" There does not appear to be sufficient grounds for the appointment of special Irrigation Presidents to try irrigation cases."

9. *G. A., C. P.*—" Difficulties experienced in Batticaloa District and other dry areas do not as a rule exist here. The Rural Courts should be able to dispose of the cases."

A final decision on this resolution could not be arrived at as the mover, Gate Mudaliyar M. S. Kariapper was absent.

(*b*) Information desired by Mr. Simon Abeywickrama on,—

(i.) The work of the Agricultural Corps.

(ii.) Progress of work at Bopatalawa and Ambewela Farms.

(iii.) The work of the Minneriya Scheme.

The Chairman said that the above information was ready and could be given at any time, but releasing that information was a matter for the Minister and that his instructions were awaited.

Mr. Wilmot A. Perera inquired whether certain information he had asked for in October, 1945, in connection with Departmental paddy farms were available.

The Chairman was of opinion that that information was released.

Mr. Wilmot A. Perera—" Not as far as I know."

The Chairman however replied that that information could be given.

Sub-Committee : Coconut Industry.

Dr. Reginald Child informed the Board that the Committee appointed to report on " What steps should be recommended to improve the Coconut Industry had met on Wednesday the 19th instant under the Chairmanship of Sir Wilfred de Soysa and that the recommendations of the Committee would be tabled at the next meeting of the Board.

III. RESOLUTIONS DEFERRED AT LAST BOARD MEETING ON NOVEMBER 18, 1946.

(i.) Gate Mudaliyar N. Wickremaratne moved,—

" This Board is of opinion that better facilities for the distribution and marketing of vegetables will not only give a better remuneration to the grower but also help to increase the production and therefore the Board request the authorities concerned to organise effective co-operative or other organisations to give effect to proper distribution and marketing of vegetables. "

Gate Mudaliyar Wickremaratne had sent the following arguments in support :—

During the past few years those of us who were about the country have seen the ill effects of the existing methods of the distribution and marketing of vegetables in the country. In nearly ninety-nine out of a hundred cases the grower does not get the price he deserves for his efforts to grow vegetables and the consumer pays a hundred per cent. more than the actual price of the commodity.

Again the congestion of certain commodities in certain localities and the scarcity of the same commodity in other localities were noticeable in every part of the country. While a lime fruit is sold in Colombo at 10 cents a fruit, I came across places where limes were sold at Re. 1·50 a hundred. Recently while 100 limes were sold in Kandy market at 65 cents, these were sold in Colombo at 3 or 4 cents a fruit. This is only one instance where facilities are not given to proper distribution.

In these cases the grower has no chance of getting what he should get and the consumer pays to enrich a middle-man who is unduly benefited as a result of the existing method of distribution and marketing as for want of no method. What we want are proper marketing surveys, and proper organisations to deal with the grower and the standardization and stabilization should follow.

I commend this proposal and request the Board to urge the authorities to give a fair deal to the vegetable grower for his property and to make him to grow sufficient produce for the use of the consumer."

Gate Mudaliyar Wickremaratne felt that although it was a long time since this resolution was introduced, conditions had not changed and therefore it could be discussed even that day. Mudaliyar Wickremaratne had sent in a memorandum in connection with this resolution. He was glad that Mr. Bassett was present and hoped he would speak on the subject. A few days earlier Mudaliyar Wickremaratne had received a Marketing Bulletin which showed that that motion had done some good. After some years the Marketing Commissioner had issued instructions to help the vegetable grower. He felt that that should have been published with the appointment of a Marketing Officer. About the year 1930 that matter had been brought up at a discussion where the Minister himself was present, but the Head of the Co-operative Department felt that they had enough work to carry on and therefore they were not prepared to undertake co-operative marketing of vegetables. They were of opinion that there should be either a separate Officer or a separate Department for the purpose. He, however, did not agree with that view that the Co-operative Department should be separate because he felt that the Co-operative Department was formed to improve village agriculture as well and therefore it should have been attached to the Department of Agriculture. He stressed that just as education in this country without religion would not do any good, no amount of Co-operative work would do any good unless Co-operative work was done in association with Agriculture. Commenting on the activities of the Marketing Department he added that with the formation of the Marketing Department one of the best Civil Servants was appointed as Marketing Commissioner, "who had started publishing bulletins." The Department was intended to help the producer to market his vegetables, but those bulletins had not helped the producer at all. He explained at length how useful it would be to send an Officer round to contact the producer and help him to get the maximum benefit for his labour. At the time Mudaliyar Wickremaratne retired from service, he had offered his services to the Marketing Department as an Information Officer. He had done that for 2 years and ultimately had to give up through sheer disgust. The first thing Mudaliyar Wickremaratne had noticed after the Marketing Department was inaugurated was that the Commissioner had raised the prices of articles. The Marketing Commissioner had started grading vegetables and they were sold by weight. About 75 per cent. of the people who deal in vegetables have no weights and measures. Even eggs had been graded and the prices had been raised sometimes up to 30 cents. He emphasized that it was not the grower who received that benefit. Growers did not receive an adequate price for their vegetables although high prices ruled for vegetables in towns. It was the middle-man who was benefited while the producer was harrassed. Prices of vegetables have been given in the Bulletin, but he wondered whether those prices helped the growers at all. He stressed that co-operative marketing was the means by which the grower would receive the most benefit but the two departments went their separate ways. The Marketing Department called for tenders for the supply of vegetables. "If the Marketing Department was formed to help the villager and to do away with the middle-man, why call for tenders ?" he asked.—"Can the villagers tender and supply vegetables to the Marketing Commissioner ?" He explained at length the various difficulties encountered by growers in transporting their vegetables and inquired why the Marketing Department did not arrange for a system of transport that would help the villagers instead of leaving them at the mercy of dealers. He remarked —"The trouble was that local conditions were not known to the Marketing Commissioner and his Officers. The Officers should have studied the local conditions and tried to help the people." There were men from distant places like Matara who come to buy vegetables from the producer and he inquired why the Marketing Commissioner himself could not have such an organisation. Mudaliyar Wickremaratne said that the Commissioner for Development of Agricultural Marketing had got a number of lorries in his Department and asked why he could not organise a means of helping the villager by transporting his vegetables. The last time when Gate

Mudaliyar Wickremaratne happened to pass through Welimada he had observed the Co-operative Society experiencing some hardship with regard to transport. As the vegetables came from long distances they could not be kept for 2 or 3 days and he felt that if there were two more lorries it would be easy to cope with. People in places like Colombo had to pay very high prices for vegetables and if more Co-operative Societies were started the consumer would get vegetables at a fair price and the producer would also get a fair price for his labour.

Mr. S. L. Bandara Dharmakirti seconded the motion.

Rev. Fr. Wickremasinghe while supporting Gate Mudaliyar Wickremaratne's resolution said that there was a good deal of truth in what Mudaliyar Wickremaratne had said. He had never seen such a glut of vegetables as at Ambalantota recently, where vegetables lay on the roadside for two days due to lack of transport ; but although there was such a glut, the prices in Colombo and all over the Island did not go down. During the war these soaring prices were due to the soldier population, but now there is nothing of the kind. Yet it was not the grower who got the benefit for his trouble but it was the middle-man. Lorry drivers sometimes with the owners form themselves into a ring, fix the prices themselves and buy at uneconomic prices to the producer, who finds it impossible to bring the vegetables to the market-place due to lack of transport. He was personally aware that for the transport of vegetables from a distance of 6 miles, the villager had to pay 20 cents for each wattakka. He had spoken to the Marketing Commissioner about this and he hoped that a van of the Marketing Commissioner going there would at least give a good price for the grower.

Sir Wilfred de Soysa said that the high prices of vegetables in Colombo was due to a monopoly of the stalls in the market by men trading under different names. He said that that was one of the reasons why prices of vegetables in Colombo could not be kept down.

Mr. R. H. Bassett first of all apologised to Gate Mudaliyar Wickremaratne for his absence from the last meeting necessitating the postponement of the Resolution. He distributed copies of the Marketing Bulletin for January, 1947, among the members for their information. He stated that the collection of vegetables in the Island, the Marketing Department transport, and the satisfaction the Co-operative Societies and others had experienced from the Marketing Department should be taken into consideration. He said that his Department did exactly what it was alleged was not doing. As regards the collection, his Department spent 5 or 6 million rupees a year collecting vegetables from the producer. Collection was done by Marketing Officers in Marketing Department lorries. " Our transport is there, our collection is there, and the vegetables are got from the producers and not from the middlemen. I think the trouble is that the critics of the Marketing Department do not get about enough." It was presumed by the mover that there is no Marketing survey, no collection by Marketing Department and no transport. No sufficient use was made of the Marketing Department. There were Marketing Officers all over the Island. Marketing Officers are well experienced men, but people do not make sufficient use of them. Growers also do not make enough use of the Bulletin which has now returned to very nearly the pre-war standard. In the latest number he had also reproduced the provisions of the Agricultural Produce Agents Registration Ordinance which was passed in 1941. But unfortunately soon after it was passed the war broke out and its implementation was not possible. Regarding the question of Tenders, he emphasized that Tenders really had nothing to do with marketing at all. They were intended to give the Department a line on the prices of vegetables in connection with Hospital supplies. They had practically nothing to do with the purchases of the Marketing Department. The Department had bought very little by Tenders. What the Department bought was of a very high grade from the Producer. As regards this matter helping Growers' Co-operative Societies, the Co-operative Society at Palugama was asked to sell their stuff to the Marketing Department

and invariably they refused to do so because the middleman offered them a better bargain. The Department used to buy about 5 or 6 million rupees worth of vegetables from Ceylon producers. Marketing Officers go round and buy vegetables from all over the Island. The Marketing Department prices are fixed in such a way as to give the consumer a fair price. The Department does the collection and the Department can give it cheaper than anyone. He stressed the importance of economic production of vegetables. " Vegetable marketing is applied economics. It constituted the relationship to the producer, the agency and the consumer. We cannot be successful in vegetable growing if we tried to break the laws of Economics. That is what Mudaliyar's resolution suggests us to do. The economic point consistently ignored in Ceylon is that marketing whether by private enterprise, co-operative Society or an efficient Marketing Department can never be the remedy for un-economic production. Your crop must have utility, both place utility and time utility. If not, no Marketing organization in the world can give you profit. However good Ceylon may be for vegetables, it is no good growing it in a place where no one wants it. It is no good growing a crop like Manioc or Wattakka or whatever it is, in a place where nobody wants it. At a time when everybody has grown it, there is a glut. The presence of the Services provided a temporary and artificial alleviation of this problem." Mr. Basset emphasized that this was the economic situation and had to be faced. They needed planned production but what they had was haphazard planting mainly unguided and even regardless of advice. The farmer's problem could be solved by co-ordinated and co-operative planning of crops. No separate Department can do it except the District Agricultural Committees or some such small units which knew their areas. He emphasized that the Marketing Department was ready to give advice with its 12 years of experience " not of the amateur but of the pretty successful business concern." As far as he was aware no Marketing Officer had ever been invited to a District Agricultural Committee Meeting. That was a meeting where crop planning could be organised as is done in England with tremendous success. But it does not appear to have been done in Ceylon. It needed the farmer, the producer, the Co-operative, Agricultural Officer, Marketing Officer. For example what crop a villager in a place 10 miles away from town should grow, &c., were problems that should be discussed. " First find out what you can grow which do not involve waste of time, waste of crop and loss of money. Do not grow crops where you cannot sell it." Commenting on the Sunday fairs, Mr. Bassett said that sometimes when a person brought brinjals for sale his neighbour also brought brinjals whereas he should try to take it to a man who has no brinjals. " You have got to grow what the consumer wants and produce it when he wants it and at the time he wants it and at the price he wants it. If you cannot do that you are a failure." For years he had been preaching the truth that vegetables could not be grown except near large towns as a money crop. Vegetables were essentially a food crop and no more. He said it was no good the Marketing Department buying crops that nobody wants to eat. Ceylon could not become a nation of Market Gardeners. There isn't a big enough urban population. The country is not short of vegetables. But prices of vegetables were still high because wages had risen, and petrol, tyres and the cost of transport had increased and the standard of living generally improved. It costs more and everybody gets more money. Middlemen were blamed, he said, and inquired how many middlemen retired rich men.

Gate Mudaliyar Wickremaratne replied that there was one person whom he knew who had made profits of about sixty thousand rupees.

Mr. R. H. Bassett—" I am glad to hear there is at least one man." (*Laughter.*)

" I am a middleman myself and I know what it costs." He explained the difficulties that are encountered especially with regard to transport and what it costs when a lorry breaks down. " You can take it from me that the vegetable grower gets a fair price for his produce.

A man who produced something which nobody wants complained he gets nothing." The remedy is to grow your crops planned by your Agricultural Committees and learn from experience. Unplanned, uneconomic, haphazard enterprise was no use.

Gate Mudaliyar Wickremaratne in reply to Mr. Bassett said that it was a very unpleasant duty to say all that he thought of the Marketing Commissioner and thereby annoy the members of the Board. He emphasized that it was the Marketing Commissioner's duty to find out the producer and give him facilities to sell his produce to the consumer. Just as the Agricultural Department was there to help the grower, the Marketing Department was there to help the producer.

Mudaliyar Wickremaratne referred to a remark the Marketing Commissioner had made that it was the work of the District Agricultural Committees to invite the Marketing Officer. The Marketing Commissioner was a member of the Agricultural Board from the time he started the Department. "Did he come before this Board even once and say that he could not do his duty because the Agricultural Committees did not help him," inquired Mudaliyar Wickremaratne. "We must go to them and not that they must come to us," he reiterated. As for the choice of crops he said, all Chena Crops were grown at the same time and wattakka for instance was grown during the same season. What the Marketing Commissioner had to do was to create a demand and not to exploit the vegetable grower. He said that prices of vegetables in Colombo were very high and that a pound of wattakka was selling for 25 cents.

Mr. Bassett at this stage pointed out that it was being sold at 6 cents a pound in Colombo.

Mudaliyar Wickremaratne continued—"What is the good of telling don't grow vegetables in a place where you can't sell it. It is no argument. Then what is the purpose of Government appointing a Marketing Commissioner ?" Gate Mudaliyar Wickremaratne concluded that he did not want to annoy the members of the House with a long speech. He hoped that the resolution would be passed and that the Marketing Commissioner would organise the most feasible way of helping the grower with the help of the Agricultural Committees, the Co-operative Department and the Agricultural Department.

The motion was put to the House and the Chairman remarked that he did not think that as the resolution stood it would in any way interfere with the freedom of action of Mr. Bassett's Department.

The motion was carried,—ten voting in favour and four against. The rest declined to vote.

(ii.) A resolution to be moved by Mr. H. Q. M. Jayawardena, for the formation of Agricultural Guilds, *viz.* :—

> **"That the Agricultural Department through the propaganda section should sponsor the formation of Agricultural Guilds to coincide as far as possible, with the D. R. O's division as Parliamentary electorate."**

Mr. H. Q. M. Jayawardene had sent in the following reasons in support :—

> I have in mind an Association similar to a limited liability company with an authorised capital and investments in shares. The capital will vary with size and nature of the cultivated and the cultivable area of an unit. (D. R. O.'s division as Parliamentary electorate) and the needs of the cultivators. A share should not exceed Rs. 2·50 in order to attract every cultivator in a unit to be a shareholder and enjoy the benefits of the movement. The tentative objects of these guilds will be as follows :—
>
> (*a*) To procure and hire out tractors, &c., to cultivators. This will be confined to flat countries like N.-C. P., E. P., N.-W. P., N. P., and S. P. As it is, cultivators have to wait for the rains and in most cases till the tank

is full to begin cultivation operations. This method involves waste of precious water and delay in commencement and completion of cultivations. This has often resulted in low yields and failure of paddy crops. If tractors are made available, ploughing and harrowing which form the most difficult part of a paddy cultivator's job, can be done during dry weather. This will enable the cultivators to adhere to a uniform programme of work, make maximum use of rain water, save up tank water, &c., and thereby eliminate the failure of crops—which is an ever-recurring source of disappointment to the cultivator.

(*b*) To procure and make available to cultivators agricultural implements at almost cost price,—*e.g.*, light iron ploughs, Burmese harrows, mamoties, &c. At present there is a fair demand for light iron ploughs and I do not think the Agricultural Department can meet this—mamoties are sold at high prices and this is hard for the cultivator.

(*c*) To procure and make available to cultivators fencing materials.—The time has come when the cultivator is called upon to rely on something other than nature to solve this difficult problem. With the felling of jungle and expansion of agricultural extents the villager is at a loss to find the means of protecting his cultivations. The live-fence sounds well but this does not give sufficient protection against semi-wild cattle or even herds of the domesticated cattle. Therefore, we have to evolve a better and sounder method of protecting village paddy cultivations. An Agricultural Guild will be in a position to procure concrete fence posts and barbed-wire and make these available to the cultivator on a hire-purchase system basing the price a little above the cost.—This will be the greatest boon to a cultivator.

(*d*) To maintain Buffalo Farms and hire out to cultivators at economic rates.—Although tractors would be available *vide* (*a*) above, buffaloes for threshing, &c., are necessary. Today the "have-nots" have to depend on the "haves" for buffaloes and they have to pay prohibitive rates.

(*e*) To give loans to *bona fide* applicants among members of the guild, for cultivation purposes.—This will remove that usurious trader from a cultivator's scheme of things and this would be to his great advantage. This aspect will overlap with the objects of Co-operative Credit Societies. Since both these institutions would exist for the benefit of the cultivators, there can be no charge of under-cutting. Recoveries of loans will be made in kind.

(*f*) To establish and encourage subvention seed farms.—This will increase the pure-line seed paddy in a unit.

(*g*) To establish paddy and other produce purchase centres.—This is very necessary for the welfare of our cultivators. The middleman will be thrown overboard and the cultivator will derive maximum benefit.

(*h*) To establish milling centres.—This is a great asset to an agricultural guild and its members.

(*i*) Generally to promote agriculture within its sphere.—My scheme may appear too far-reaching and somewhat beyond the capabilities of the average farmers, who will form the bulk of the membership, but

left to themselves, it is bound to fail for lack of organising talent. It is for this reason that I suggest that the Propaganda Branch of the Agricultural Department should step in and do the pioneering work in setting up this great national project—For success, I suggest that we take up one electorate in N.-C. P. and concentrate our attention there—This is the time to start a thing of this nature as financial support of the cultivator can be expected in view of the I. P. S. There is no doubt that this will be a success as it is most standard of agriculture. The old methods must yield to new, and the Government which helps in these matters will even be acknowledged a good Government."

This resolution lapsed in the absence of the mover.

(iii.) A resolution moved by Gate Mudaliyar M. S. Kariapper on " Irrigation Presidents."

" That this Board is of opinion that as the present system of inquiring into offences committed under the Irrigation Ordinance in V. T. Courts caused considerable hardships to the villagers in the Batticaloa District owing to the length of time involved in obtaining redress, Government should revert to the practice of appointing Irrigation Presidents as early as possible. "

Mudaliyar Kariapper had sent the following arguments in support :—

" The resolution is self-explanatory. Prompt disposal of irrigation cases makes more than 50 per cent. All the difference between the success and failure of a crop. This is essentially so in the Batticaloa District, where paddy fields are paddy fields only for three months and are pasture grounds during the rest of the year. This, so to say, co-ownership of the land between the paddy plant and the cattle, requires the over-watchful and quick eye of the law to prevent aggression. And what's more, the present-day cultivation labourers, styling themselves " Cooly-men " (a class in their opinion a wee bit superior to " gentlemen ") are developing a spirit of indifference in regard to fencing, watching, &c., that unless the rod of the law is ever present for prompt application to their back, paddy cultivation will become merely the growing of fodder for cattle, wild beasts and birds."

A final decision on this resolution could not be arrived at. Please see in this connection, (under—II. Matters Arising out of Minutes) the information obtained from Government Agents and Assistant Government Agents on the subject.

In the absence of the mover, the resolution lapsed.

Col. T. Y. Wright inquired whether that resolution could come up again.

The Chairman replied in the negative.

IV. NEW RESOLUTIONS.

(*a*) Gate Mudaliyar S. Muttutamby moved,—

" As the current procedure, according to which the operations in connection with the irrigation of paddy cultivation are shared by the Irrigation Department and the Government Agent, leads to inefficiency and loss of crops, steps should be taken to place the sole responsibility on the Irrigation Department for supplying the water required for cultivation.

The following arguments were sent in support of the resolution :—

" Water is supplied through channels constructed and maintained by the Irrigation Department. When cultivation starts, the Government Agent through his subordinate officers assumes control of the channels so far as the water distribution is concerned ; the work of the Irrigation Officer is confined to

opening the main sluices as required by the G. A. Overseers and coolies are employed by the Irrigation Engineer while the G. A., has Village Cultivation Officers, Overseers and Kama-Vidanes. Both sets of employees are working in the same area independently of each other. There is sometimes rivalry between them, but no co-ordination at any time. Between one cultivation and the next the channel passes into the charge of the Irrigation Department for few weeks and they are expected to put the channels in proper trim. Some of the planks used in the sluices, D'gates, &c., are lost while the channel is under control of the Government Agent, and Irrigation Engineers are not able to provide them at such short notice. This divided responsibility results in much inefficiency and poor crops.

The G. A. has neither the time or the aptitude to personally supervise Irrigation and cultivation works. He depends entirely on the Village Cultivation Officers who are young men of no training or experience. As the responsibility is on the G. A. the faults committed by these Officers are passed over in silence. The I. E. refrains from pointing them out. The poor villagers will not dare to make complaints against the G. A. The result is the parlous state into which paddy cultivation has fallen. It is a vicious system and should be amended if better results are to be obtained."

Gate Mudaliyar Muttutamby said that when there was a Reservoir and a Channel and when for instance a Yala crop was to be cultivated, the Irrigation Engineer reported upon the area that could be cultivated according to the water available in the reservoir. Thereafter control of the distribution of water passed into the hands of the Government Agent. When it passed on to the Government Agent, each cultivation officer under him tried to get as much water as he wanted for his own area. The Cultivation Officer goes to the Government Agent and asks him to get the sluice opened for watering his area. Once this was done the responsibility of the Irrigation Engineer ceased and the G. A. was himself responsible. As a result, some fields suffered a scarcity of water while in others, a good amount of water went waste. The result was that in some fields the Yala crop was a complete failure. Mudaliyar Muttutamby suggested that some steps should be taken to go back to the old practice of making the Irrigation Engineer responsible until the crop was reaped because the present system of sharing the responsibility between the Irrigation Engineer and the Government Agent led to inefficiency. Gate Mudaliyar Muttutamby also suggested that Irrigation Overseers and Cultivation Officers should come under one Department if they were to work efficiently.

Mr. Wilmot A. Perera seconded the resolution and said that he had personal experience in this matter of unsatisfactory distribution of water to paddy fields.

Mudaliyar Abulcassim Marakar speaking on the resolution said that the Director of Irrigation would have certain observations to make because it came within the purview of the Irrigation Ordinance. While supporting the resolution, he pointed out certain practical difficulties that would have to be encountered. The first difficulty was that the Irrigation Ordinance would have to be amended in the event the resolution had to be implemented. Secondly there was no co-ordination at present between the Irrigation Department and the Revenue Officers. Another difficulty was that Kama Vidanes were elected by the villagers but had to work under the Government Agents. Supervision of Village Cultivation Officers was also entirely in the hands of the Government Agents, so that if there were a change in the policy or procedure, all those officers would have to come under the Irrigation Department. For that purpose the Irrigation Department should have a big staff. That was an Island-wide procedure and if it were changed, cultivators would not get the same service which they were getting at present from Government Agents and Assistant Government Agents.

He also emphasized the difficulty of bringing paddy cultivation to a success especially in the Mannar District. " One main draw-back is, we cannot do methodical cultivation owing to the vagaries of the weather conditions. When we require rains we cannot get the rains. I do not know whether there is any solution, because we have got to depend on nature." He said he was in full support of the resolution, but those were difficulties he could foresee in the event of the resolution being implemented.

Madawala Dissawa speaking on the resolution said that cultivation was supervised by Government Agents and he wondered whether the Irrigation Department would take it up. He therefore suggested that before the House could go further into the subject it was better to ask the Director of Irrigation for his views.

Mr. S. G. Taylor, Director of Irrigation, stated that dual control was of course not conducive to efficient working and from that point of view he was in entire agreement with the mover, as it was good to have control vested in one authority. He pointed out that mere transfer from one department to another would not remove all the troubles mentioned by the speakers. If the system was to be changed it must be changed for the better and for that purpose he did not have the staff. At the present moment, he said, it would be impossible for his Department to take it up. To go back to the system that prevailed before 1922 which was the effect of the resolution, a separate organisation would have to be started and do nothing but attend to the issue, control and conservation of water. He agreed with Mudaliyar Abulcassim Marakar that if the motion was implemented the amendment of the Irrigation Ordinance would be necessary. He said that it would mean a complete revision of the Irrigation Ordinance. The Director of Irrigation was in support of that resolution but he felt that immediate effect could not be given to it.

Rev. Fr. L. W. Wickremasinghe felt that as the new system had not been long in operation it would be better to watch its working for sometime before changing it back to the old system. He stressed the difficulty that when the Irrigation Department was in complete charge of the distribution of water, Yala crops failed completely in some areas because water was sold. Once at Tissamaharama, when there was 6 feet of water in the tank one evening, information reached him the next morning that the water level had come down to 2 feet. He had taken the A. G. A. round personally and had shown him that when water was knee-deep in certain fields, others were practically dry. He stressed that in spite of this, the officer concerned was only lowered in rank and transferred to another station "and not even dismissed." He added—"The Cultivator has no chance whatever when the Irrigation Officer is in charge." He felt that it was a big risk to change the present procedure in this matter.

Col. T. Y. Wright while supporting the motion, remarked—" The trouble is, the people in charge, are not doing their job."

Poholiyadda Dissawa felt that the resolution referred to major tanks. He said what happened in the North-Central Province was when the tank was full or when it had got its water, with the assistance of the cultivators the share-holders were summoned by the Government Agent and there the Irrigation Officer had to advise the G. A. technically. If the tank had not got sufficient water at that time, anticipating the rains, the extent to be cultivated was fixed. He was of opinion that if the two departments were amalgamated the working might be better, but he said it was very surprising to hear that the Irrigation Department was in the habit of selling water. He said that the people might be seeking the help of the Vel Vidanes to get certain things done, but the Irrigation Department could not be blamed as being in the habit of selling water.

Gate Mudaliyar Wickremaratne supported the views of Rev. Fr. Wickremasinghe. He said that in 1910 when the distribution of water was in the hands of the Irrigation Department

there were certain crops dying for want of water at Tissamaharama. The Irrigation Department had not allowed the water. The G. A. visited the place and found certain fields coming up beautifully with knee-deep of water while other fields were dying.

Mr. S. Sivapalan stated that channels were for instance under the supervision of Government Agents for a certain distance and then again they came under the supervision of the Irrigation Department. As a result much of the water that could be usefully utilised went waste. He added—" Our main idea is to conserve the water and use it in the best possible manner." He was in support of the motion.

Mr. H. W. Amarasuriya said that he had been following the discussion very closely. The Director of Irrigation had pointed out that the suggestion could not be given effect to immediately. Mr. Amarasuriya inquired whether some arrangement on the lines suggested was not possible. He suggested that if, administratively, some arrangement could be brought about for the Irrigation Officer to take orders from the G. A. in regard to the discharge of that particular duty, the difficulty could be overcome. He felt that if there was closer co-operation between the Revenue Officer and the Irrigation Officer, there would be a way out of that difficulty.

Mr. S. G. Taylor, Director of Irrigation, in reply stated that Irrigation Officers did take orders from the G. A. at present in that connection. But now it merely meant that the Irrigation Department should take on the job of the G. A. or the A. G. A. He emphasized that it was not just a case of issuing water, but there was very much more to be done. He also expressed the difficulty with regard to trials of irrigation offences, and the amendment of the Irrigation Ordinance, which he said would take some time and the difficulty of getting staff.

Col. T. Y. Wright suggested the addition of the following words to the resolution—"As soon as possible."

Gate Mudaliyar S. Muttutamby and Mr. Wilmot A. Perera agreed to the addition of these words to the resolution. Mudaliyar Muttutamby said that by that resolution he did not want to deprive the Government Agents of their authority but it was because the Government Agents did not have sufficient time to attend to that kind of work that motion was introduced. He wished if the G. AA. could order all their subordinate officers to carry out orders of the Irrigation Officer.

The resolution was put to the House as amended by Col. T. Y. Wright and was carried unanimously.

(*b*) Gate Mudaliyar N. Wickremaratne,—

" This Board earnestly requests the Minister of Agriculture and lands to be pleased to consider the advisability of appointing a commission to take stock of the present position of the cultivation of paddy and to investigate into the possibilities of developing the paddy cultivation from it and make their recommendations to make the industry attain its goal, i.e., self sufficiency. "

Gate Mudaliyar Wickremaratne withdrew this resolution.

(*c*) Rev. Fr. Wickremasinghe moved,—

" The Central Board of Agriculture recommends that the most important agricultural roads under the Irrigation Department should be metalled and tarred or be given over to the Public Works Department, and the other roads be track-metalled and tarred. "

In introducing the resolution, Rev. Father Wickremasinghe stressed the importance of agricultural roads. When certain roads were in a bad state of repair he had informed the Irrigation Engineer and the Engineer's reply had been that their roads were meant only for use during the dry weather. A road should be usable in any weather and he had suggested to the Engineer to get it tarred. Even if the Irrigation Department repaired the roads, by the time they started with the second mile, the first mile was again as bad as the second. He emphasized

that it was very unfortunate that Government Officers were all supplied with jeeps and trucks as a result of which none of the other people could use those roads. He had seen more than 50 carts broken down in those bad roads. At the present time it is impossible to repair carts because steel is not available in the market. If the Irrigation Department could not take over those repairs, it was best to hand them to the P. W. D. but he emphasized that the P. W. D. was no better ! He also gave an intance where on a gravel road heaps of gravel were available and although the road was full of deep pits, the gravel was not made use of to cover the depressions on the road. Rev. Fr. Wickremasinghe himself had got some villagers to fill them with gravel. He felt that unless those roads were repaired, the agricultural produce in those areas would become useless. In one instance on his advice the villagers had floated their wattakkas to market down a channel owing to transport difficulties. He hoped that the members would agree with him that those important roads should be metalled and tarred and the other roads should be track-metalled.

Col. T. Y. Wright seconded the resolution and said he had had experience of the mover's complaint during a visit to Kalkudah where he happened to walk through miles and miles of paddy fields served by a gravel road and everything was at a standstill due to a broken culvert. He hoped that somebody would look into it. He felt that it would have just taken a week to put it right.

Gate Mudaliyar Muttutamby inquired why only Irrigation roads should be attended to when there were a large number of P. W. D. roads too that should be taken up. He said that all roads should be improved and not a particular kind of road. The position in Mannar District was quite different. None of the P. W. D. roads in the area were usable and the only good road was the Irrigation road ! He opposed the handing over of Irrigation roads to the P. W. D.

Mr. C. A. M. de Silva—" Why should we not ask the Irrigation Department to repair these roads, themselves ? "

Mr. A. R. Panditteseker a suggested that all roads should be attended to.

Poholiyadda Dissawa—" This resolution should not apply only to Agricultural roads, but should apply to all the roads."

Mr. C. A. M. de Silva suggested the deletion of the words " or be given over to the Public Works Department."

The resolution as amended was put to the House and carried unanimously.

ANY OTHER BUSINESS.

(i.) Mr. C. A. M. de Silva inquired about the progress of research on indigenous material used as Cattle Food.

Dr. A. W. R. Joachim, Chemist of the Department said that the matter was raised by a letter from Sir Wilfred de Soysa to the Director and not by the Board. It had received the fullest attention. Analyses of 35 indigenous livestock feeding stuffs had been made and the results were sent to Sir Wilfred. Feeding tests were a more difficult matter and would certainly be done in due course. Recently an Officer of his Division, Mr. Panditteseker a, was sent to India to qualify in this line of work and he had just returned. Funds had been obtained for the work, but it would take a little time before they organised themselves. He assured Sir Wilfred that once everything got going he could let Sir Wilfred have the necessary data he wanted.

The Chairman explained that the feeding stuffs had to be subjected to actual feeding tests which could not be done in a hurry and that the results would be published in the " Tropical Agriculturist."

(ii.) Sir Wilfred de Soysa initiated a discussion on the status of the Central Board of Agriculture under the New Constitution.

Sir Wilfred de Soysa read out the present constitution and rules governing the Central Board of Agriculture and functions of the Board.

He said that rightly or wrongly there was an impression that most of the resolutions passed by the Board and sent to the Minister were not taken up for implementation. At present 7 officers of the Department were serving on the Board. Altogether there were 61 members serving on the Board. The constitution of the Central Board of Agriculture had been resolved at a meeting of the Executive Committee for Agriculture and Lands, held on June 28, 1940, under sub-sections (1) and (2) of Section 4 of the Department of Agriculture Ordinance, Chapter 304. His Excellency the Governor was to serve as President, but later on it had been amended and the Director of Agriculture took his place as President. The Vice–President was elected from the members of the Board. There were 9 members representing different Government Departments. There were 21 members, one representative elected by each District Agricultural Committee, other than the Uva and the North-Central Province which will elect two each. Two members elected by the Planters' Association, two members elected by the Low-Country Products Association, one member elected by the Ceylon Estates Proprietary Association, the Chairman of the Planters' Association, the Chairman of the Low-Country Products Association, seven officers of the Department of Agriculture. Fifteen members nominated by the Director of Agriculture, with the approval of the Hon. the Minister for Agriculture and Lands to provide for the inclusion of persons, who took a real interest in the Agriculture of the Island and who could not otherwise be included in the personnel of the Board and any person appointed by the Minister for Agriculture and Lands by notification in the *Government Gazette* to function as Secretary to the Board. In all, there are 61 members with the President and the Secretary.

Sir Wilfred felt that when the New Constitution came into operation there would be no Executive Committee to advise the Minister and in all probability the Minister of Agriculture, Mr. D. S. Senanayake, might become the Prime Minister and would not be the Minister of Agriculture. Sir Wilfred de Soysa suggested that if the members would agree, the Board should send a recommendation to the new Parliament that the Executive Committee of the Central Board of Agriculture be considered as an Advisory Committee to take the place of the Executive Committee of Agriculture since under the New Constitution the Minister of Agriculture would not have the assistance of that Committee.

The Chairman pointed out that he would like to correct a small misapprehension, and that was, that the Executive Committee of Agriculture and Lands was not acting in an advisory capacity to the Minister. The Minister was only the Chairman. Therefore, it would not be possible to make an advisory body like the Central Board of Agriculture to replace that Executive Committee.

Col. T. Y. Wright—" Sir Wilfred means that we should be an Advisory Committee to the Minister. I would like to support him in this matter. We pass resolutions and do all sorts of things and never hear what has been done."

Mr. H. W. Amarasuriya stated that under the New Constitution it was true that there would be no Executive Committee. The Minister would exercise his own judgment and come to a decision and in doing so, there would be no doubt, he would consult bodies pertaining to Agricultural matters. He took it, that the Board of Agriculture would continue. Unless the Ordinance was amended, the Board of Agriculture would continue with the same functions. Therefore, he did not think, that as rightly pointed out by the President, they could expect the Central Board of Agriculture to take the place of the present Executive Committee. It had executive functions and the Minister was only the Chairman of the Executive Committee. The Minister had to formulate the proposals according to the majority of the decisions of the Executive Committee. He inquired why Sir Wilfred de Soysa wished to have the Executive Committee of the Central Board of Agriculture only, to advise the Minister, because under the present procedure the entire Board was an advisory body and it was left to the Minister whether to accept that advice or not. It was not correct to say that the resolutions passed by the Board

had not reached the Minister. They did go as recommendations of the Executive Committee of the Board and all of them had been considered and some had been implemented although the majority of them appear to have been ignored. He felt that it would be best if the President could table a statement showing what resolutions passed by the Executive Committee to the Board had been implemented by the Executive Committee of Agriculture, because there appeared to be a misapprehension among members that the advice given by the Board was not accepted in its entirety by the Minister. When the advice was tendered to the Executive Committee of Agriculture it was left for them either to accept that advice or reject it. He added, that if the Board wished to function, it would perform the same functions and there would be no change in the status.

Mr. Wilmot A. Perera felt that unless an undertaking was given that the resolutions passed by the Board would have the Minister's consideration, this Board was practically redundant and suggested that the Board be scrapped.

The Chairman said that it was pointed out to him that all the resolutions of the Board reached every member of the Executive Committee of Agriculture and Lands for any action they might suggest on them. As to acting on them, there were difficulties sometimes. The Board saw matters only from one angle whereas the Ministers had to bring an Island-wide view to bear on them. It could however be safely accepted that their resolutions did receive consideration but being an advisory body it could not be expected that all their advice would be acted on. The Executive Committee of the Board themselves were in a quandary sometimes as to what they should report on certain resolutions. It could be imagined how much more then would the difficulties be of those who had to take action to implement them.

Col. T. Y. Wright : " Could we not hear what the Executive Committee did about them ? That's all we want to know."

Chairman.—" We have no right to do anything but to tender advice."

Gate Mudaliyar Wickremaratne opposed the policy of recommending only those resolutions which are passed by the Executive Committee of the Board. He inquired why a few members should sit in judgment over resolutions passed by other members of the Board. He said—" If 61 people cannot give advice on a subject how can 10 people give advice on that subject ?"

Mr. A. R. T. Gibbon : It is important that we should maintain continuity. In view of what Sir Wilfred said, I think some of us feel a little apprehensive lest during the period between the dissolution of the Executive Committee of Agriculture and the appointment of a new advisory committee there might be too big a time-lag.

The Chairman stated he couldn't say what the legal implications were, but if the Executive Committee appointed a new Board, continuity for the next 3 years was assured.

In England when certain problems arose, the Minister appointed *ad hoc* commissions of very responsible persons. Some of the members of the Board might be called upon to serve on such commissions. He might also be helped by experts. Nevertheless this body would have a function to perform and that is to give general advice.

Mr. A. R. T. Gibbon—" Everybody in this room is anxious to co-operate in the general improvement of Agriculture. That is why we come here—to do our best and tender advice, whether acceptable or not, it is for you as Head of the administration and the Minister to decide.

Sir Wilfred has I think very wisely brought forward this discussion to find out in what way we could help.

The Chairman suggested the appointment of a small committee to go into the question of how effectively the Central Board of Agriculture could be helpful in giving advice to the Minister of Agriculture and Fisheries under the New Constitution.

Mr. H. W. Amarasuriya asked why the Board should offer to make a recommendation in regard to the status of the Board under the New Constitution when it has not been asked to

do so. He thought the action premature. The functions of the Board were laid down by by Ordinance and until the Ordinance was amended, they would continue to perform those functions. Personally he visualised a time when the Board would gain more responsible status because the new Minister would have to look to a body like it for advice and guidance.

After further discussion, Sir Wilfred de Soysa moved and Mr. C. A. M. de Silva seconded, that the following committee be appointed under the Chairmanship of the President to go into the question of how effectively the Central Board of Agriculture could be called upon to give advice to the Minister of Agriculture and Fisheries under the New Constitution :—

Mr. L. J. Seneviratne, President, C. B. A.
Sir Wilfred de Soysa,
Sir James Obeysekera,
Col. T. Y. Wright,
Mr. C. A. M. de Silva,
Gate Mudaliyar N. Wickremaratne,
Mr. A. R. T. Gibbon,
Mr. S. Sivapalan,
A. E. Madawala Dissawa, and
Mr. M. J. Perera, the Secretary, as Convenor.

It was also decided that the Secretary should be the Convenor and that 5 should form the quorum. The first meeting was fixed for March 19, 1947, at 9.30 A.M. in the Director's room.

Col. T. Y. Wright raised the question of consultation fees of Veterinary Officers of the the Department. He gave an instance where a man from an estate near Peradeniya had been charged Rs. 20·50. Rs. 10 had been charged for travelling while the balance 10·50 had been the consultation fees. There was another case where a labourer was charged Rs. 30. She had paid Rs. 25 and she had been refused a receipt. Later, Col. Wright had asked her to pay the balance Rs. 5 and get a receipt. Col. Wright felt that if they were paid officers they ought not to charge a consultation fee.

The Chairman remarked that Rs. 10·50 as professional charges did not seem too high. He pointed out that Medical Officers in Government service were entitled to private practice and Veterinary Officers should also be treated similarly. The Chairman however pointed out that that was not a matter to be discussed at the Board and that he would look into the matter fully if Col. Wright could write a letter giving the necessary information.

The next meeting of the Central Board of Agriculture was fixed for June 30, 1947, at 2.30 P.M.

The meeting terminated at 12.30 P.M.

M. J. PERERA,
Secretary, Central Board of Agriculture.

Peradeniya, March 9, 1947.

MINUTES OF THE EIGHTY-NINTH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 2.30 P.M., ON MONDAY, SEPTEMBER 22, 1947, IN ROOM NO. 272, NEW SECRETARIAT, COLOMBO.

Present.—(1) Mr. L. J. de S. Seneviratne, C.C.S. (Chairman); (2) Mr. H. E. Peries, C.C.S., Deputy Financial Secretary; (3) Mr. C. A. M. de Silva (Chairman, L.C.P.A.); (4) Mr. Vernon Rajapakse, representing the L.C.P.A.; (5) Mr. A. Pearson, representing the P.A. of Ceylon; (6) Mr. E. Muttukumaru, representing the P.A. of Ceylon; (7) Mr. D. D. Karunaratne, J.P., M.P., representing the Small-holders; (8) Mr. G. Panditesekera, J.P., U.M., representing the Small-holders; (9) Mr. Thomas Amarasuriya.

Dr. R. Child (Director, C.R.S.).

Mr. S. C. Kahawita, (Secretary-Accountant).

An apology for absence was received from Mr. Stanley Dias.

I. MINUTES.

(*a*) *Minutes* of the previous meeting held on August 22, 1947, which had been circulated were confirmed.

(*b*) *Procedure.*—On the recommendation of the Chairman, the Board unanimously approved that when resolutions *not on the Agenda* have been passed at meetings of the Board the procedure followed should be—

(i.) When the Minutes of the Meeting are circulated, the attention of members should be specifically drawn to the resolutions under consideration, by a covering letter;

(ii.) Members will then be in a position to bring up the resolutions for discussion, with adequate notice, at the next meeting, after having them placed formally on the Agenda;

(iii.) Members to send up requests in terms of (ii.) above, within 15 days of the sending of the minutes to them;

(iv.) No action to be taken on them until the 15 days referred to in (iii.) have expired;

(v.) This procedure should apply to the resolutions passed at the last meeting.

II. STAFF.

(*a*) *Return of Dr. R. Child (Director) to the Island.*—The Chairman tabled a letter sent by Dr. R. Child informing him that he returned to the Island and assumed duties on September 5, 1947, and also expressing to the Board of Management his appreciation of the leave granted for the occasion of his marriage.

(*b*) *Senior Field Assistant to Soil Chemist.*—The appointment of Mr. R. B. Rodrigo as Senior Field Assistant to Soil Chemist as from September 1, 1947, on the advertised terms of service was ratified.

(*c*) *Junior Technical Assistant to Soil Chemist.*—A letter dated August 21, 1947, from the Soil Chemist was read advocating the appointment of a Junior Technical Assistant to the Soil Chemist's Division, so as to relieve the present Technical Assistant from much routine

analytical work. This was referred for report to the Director, who was asked to indicate particularly what new work the present Technical Assistant would take up if the appointment was approved.

III. 1. VARIETIES BLOCK.

The Board accepted the Sub-Committee's Recommendation that after the present season, no further food crops should be grown in this area. Food crops to the requirements of the Ordinance should be preferably grown in the existing planted up areas and not in new clearings intended for experimental work.

(ii.) The question of the planting in May–June, 1948, of the varieties block of 24 acres was referred to the Director for report.

(iii.) The Board agreed with the observations of the Sub-Committee that manuring manioc plants is uneconomical.

2. PADDY FIELDS.

The low-lying area on either side of the present paddy fields as recommended by the Sub-Committee should be given on a long lease to the villagers together with the existing paddy field for asweddumizing and cultivating on a share basis.

IV. ESTATES MONTHLY REPORTS.

The monthly reports on the estates for August, 1947, which had been circulated were approved without comment.

V. FINANCE.

(*a*) *Financial position of the Scheme* :—The Deputy Financial Secretary informed the Board that Financial provision for the Coconut Research Scheme has been approved by the Board of Ministers in the form of a Supplementary Estimate and is awaiting the Governor's sanction. This was greeted with acclamation.

(*b*) *Estimates and Programmes for 1948*.—(i.) *Estimates* for 1948 which had been circulated with detailed notes on Income and Expenditure were approved without any amendments.

VI. ANY OTHER BUSINESS.

The Board decided to hold its next meeting on Monday, November 24, at 10.30 A.M. at Bandirippuwa estate, Lunuwila.

The meeting terminated at 3.30 P.M. with a vote of thanks to the Chair.

By order,

S. C. KAHAWITA,
Secretary, C. R. S.

September 26, 1947.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT THE ROOMS OF THE CEYLON TEA PROPAGANDA BOARD, PRINCE STREET, COLOMBO, ON MONDAY, MAY 19, 1947, AT 2.30 P.M.

Present.—Mr. R. C. Scott, C.B.E., Chairman ; The Acting Financial Secretary (Mr. C. E. Jones, C.C.S.) ; The Director of Agriculture (Mr. L. J. de S. Seneviratne, C.C.S) ; The Chairman, Planters' Association of Ceylon (Mr. R. Singleton Salmon) ; Messrs. S. Vytilingam, M.S.C. ; F. Amarasuriya ; W. H. Attfield ; H. S. Hurst ; W. H. Gourlay ; G. K. Newton and Dr. T. Eden (Acting Director and Secretary).

Apologies for absence were received from the Chairman, Ceylon Estates Proprietary Association (Mr. C. A. Meakin) and Mr. W. W. A. Phillips.

1. **THE NOTICE CONVENING THE NOTICE WAS READ.**

Mr. R. Singleton Salmon, who had been Acting Chairman, welcomed Mr. R. C. Scott back to the Chair on behalf of the Members of the Board.

2. **THE MINUTES OF THE MEETING HELD ON FEBRUARY 17, 1947 WERE CONFIRMED.**

Arising out of the minutes the Chairman reported that the Director of Agriculture's queries under item 8 (Agricultural Policy) had been answered by the Secretary of the Estate and Experimental Sub-Committee. He asked whether the Director of Agriculture was satisfied with the answers. The Director of Agriculture replied in the affirmative and asked if the experimental work relating to that policy had been published. The Acting Director replied that it had.

3. **MEMBERSHIP OF THE BOARD.**

Reported that the following changes in personnel of the Board and Committees had taken place since the last meeting :—

(*a*) *Board.*—

(i.) Mr. R. C. Scott, C.B.E., relieved Mr. E. G. Groves and resumed Chairmanship on return from leave.

(ii.) Mr. R. Singleton Salmon relinquished post of Acting Chairman, T. R. I.

(iii.) Mr. G. K. Newton is nominated by the Ceylon Estates Proprietary Association, *vice* Mr. F. A. Bond (on furlough).

(iv.) Mr. W. W. A. Phillips is nominated by the Planters' Association of Ceylon *vice* Mr. Wilkinson Kay (resigned).

(*b*) *Estate and Experimental Sub-Committee.*—

Mr. R. C. Scott, C.B.E., relieved Mr. S. Bolster.

The Chairman expressed appreciation of Mr. R. Singleton Salmon's tenure of the office of Acting Chairman. The Secretary was instructed to send the thanks of the Board to the retiring members for their services.

Mr. E. G. Groves was appointed to the Estate and Experimental Sub-Committee in place of Mr. F. A. Bond.

4. **FINANCE.**

Reported that the Auditors' report for the year 1946 had not come to hand as expected.

5. **SALE OF ST. COOMBS TEAS.**

Reported that voting by letter on the question of St. Coombs teas had resulted as follows :—

In favour of selling on the open market	7
In favour of contract	4
Abstained	1
Total ..	12

In accordance with the vote, no teas had been offered on contract. This action was confirmed unanimously.

Reported that in consideration of this vote no tea had been offered for the Internal Purchase Scheme.

6. **AMENDMENT OF TEA RESEARCH INSTITUTE ORDINANCE.**

The draft prepared by the Institute's Solicitors was considered by the Board.

Clause 3 (*a*) (1) was amended to read : By deleting the words—

" The Financial Secretary, or if the Financial Secretary is unable to be present at any Meeting of the Board, the Deputy Financial Secretary " and substituting therefor the words " The Financial Secretary *or* the Minister for Finance or their nominee."

(The question of the ambiguity of the phrase ' their nominee ' to be referred back to the Solicitors).

Clause 3 (*a*) (2) For " *Vice Chairman* of the Planting Committee " substitute " *Chairman* ".

Clause 3 (*a*) (3) For " *Vice Chairman* of the Agency Section " substitute " *Chairman* ".

In regard to Clause 4, the Director of Agriculture pointed out that the present draft included alterations that were more far reaching than the original proposals concerned with the Junior Staff Provident Fund and that the support of the Minister for Agriculture and Lands was necessary before proceeding further.

Finally, the following resolutions were agreed upon :—

(*a*) That section 4 of the draft be deleted.

(*b*) That a case for increased funds should be prepared in detail. (Proposed by Mr. W. H. Gourlay ; seconded by the Director of Agriculture and carried unanimously).

(*c*) That the amended draft should be referred to the Planters' Association Sectional Committees for criticism and that the final draft be sent to the Minister of Agriculture. (Proposed by Mr. H. S. Hurst and seconded by Mr. W. H. Attfield and carried *nen-con.*)

7. **SMALL HOLDINGS.**

(*a*) Reported that Mr. M. B. Boange, Small Holdings Officer, Morawak korale, had resigned. Dr. F. R. Tubbs, who was shortly visiting the Morawak korale Planters' Association, was instructed to report on the views of the P. A. regarding the Small Holdings work in that area.

(*b*) A letter was read from a proprietor in Uda Pussellawa urging the establishment of small holdings advisory work in that area. The Acting Director had replied stating that this request would be placed before the Board, and pointing out that until more funds were available further extension was impossible. This reply was confirmed.

8. **STAFF.**

(*a*) Reported that Dr. Gadd, who was acting for the Director, had left on furlough on May 10, and that Dr. Eden had succeeded to the Acting appointment on May 1, 1947.

(*b*) *Dearness Allowance to Senior Staff.*—Reported that the Finance Committee had considered the question of an increase in the dearness allowance to the Senior Staff and had recommended unanimously that senior officers should receive Rs. 350 (married) and Rs .250 (single) per month with effect from January 1, 1947. On the motion of Mr. H. S. Hurst seconded by Mr. R. Singleton Salmon, the Finance Committee's recommendation was unanimously adopted. The Acting Director thanked the Board on behalf of the Senior Staff.

(*c*) *Appointment of Research Assistant in the Biochemical Department.*—The Acting Director reported the steps taken to fill the vacancy created by the resignation of Dr. H. B. Sreerangachar by recruitment of a qualified officer in Ceylon. No such officer being available at the salary the Institute is empowered to offer, he submitted for appointment the name of Mr. M. S. Ramaswamy of the Indian Institute of Science. After considering the applicant's qualifications and the Acting Director's report on them, it was agreed unanimously to offer Mr. M. S. Ramaswamy the appointment on the existing salary scale.

9. **ESTATE AND EXPERIMENTAL SUB-COMMITTEE.**

The Minutes of the Meeting of April 2, 1947, were received.

Mr. W. H. Gourlay asked if the interim information on Blister Blight could be expeditiously published. The Acting Director enumerated the difficulties in getting extra information printed, but said that the Press had co-operated promptly in publishing the full text of Dr. Tubbs's most recent lecture, and every effort would be made to keep information up-to-date.

The Director of Agriculture asked whether the work done so far on Blister Blight showed any advance on that carried out in other countries.

In his reply the Acting Director said that the Institute had already added substantially to the published information on the morphology and ecology of the fungus. As regards control methods, the experience in other countries was only generally applicable here. Modifications and extension of existing methods were being actively pursued. He remarked on Dr. Tubbs's very conscientious and energetic conduct of the work in hand.

The Meeting concluded with a vote of thanks to the Chair.

ROLAND V. NORRIS,
Secretary.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle, June 20, 1947.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE EIGHTY-FOURTH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE SECRETARIAT, COLOMBO, AT 2.30 P.M. ON MONDAY, JULY 28, 1947.

Present.—Mr. L. J. Seneviratne, C.C.S. (in the Chair) ; Mr. H. E. Peries, C.C.S. (Deputy Financial Secretary) ; Mr. W. H. Attfield ; Mr. W. P. H. Dias, J.P. ; Mr. A. M. Clement Dias ; Mr. T. C. A de Soysa ; Mr. Noel de Silva ; Mr. J. D. Farquharson, J.P., U.M. ; Mr. R. J. Hartley ; Mr. A. D. Layton ; Mr. R. C. L. Notley, and Col. J. T. Young.

Dr. E. Rhodes, Director, was present by invitation.

Apologies for absence were received from Messrs. Thomas Amarasuriya, M.S.C., and Simon Abeywickreme, M.S.C.

1. MINUTES.

Draft minutes of the meeting held on May 12, 1947, which had been circulated to members, were signed by the Chairman on signification of members' assent that they were in order.

2. DECISIONS BY CIRCULATION OF PAPERS.

(*a*) *Board membership.*—Reported that the Hon. Mr. G. E. de Silva, M.S.C, had been restored to membership by the decision of a majority of members.

(*b*) *Purchase of latex.*—Agreed that latex be purchased for the manufacture of sole crepe when the Director considered that this could be done. The price to be paid was left to the Director's discretion.

Mr. W. H. Attfield and Mr. H. E. Peries came into the meeting.

3. SMALLHOLDINGS COMMITTEE.

Recommendations made at meeting held on July 7, 1947 :—

(*a*) *Rubber Instructors' salary scale.*—As recommended by the Committee, the creation of a senior grade of Instructor on a salary scale of Rs. 100—10—250 per month to which officers of special merit might be promoted after not less than five years' service was approved.

(*b*) *Deputy and Clerk for S. H. P. O.*—

Deputy.—After considerable discussion the Committee's recommendation that a deputy S. H. P. O. be appointed on a salary scale of Rs. 300—25—600 per month was approved subject to alteration of the qualifications required of candidates.

Clerk.—The recommendation that an extra clerk be appointed to the Smallholdings Department was approved and it was agreed that the appointment should be made on the terms laid down for clerks.

The minutes were adopted.

4. EXPERIMENTAL COMMITTEE.

Recommendations made at meeting held on July 15, 1947 :—

(*a*) *Visiting Agent's Report*—

Bungalows.—The recommendation that a telephone extension be provided at the Estate Superintendent's bungalow was approved.

Factory and Machinery.—The recommendation that a new roll be purchased for the 26-inch smooth mill was approved.

Hedigalla Lines.—The recommendation that ramps and drains be provided for the following buildings was approved and a vote passed to cover their cost :—

Quadruple cottage at Hedigalla,
Conductor's bungalow at Hedigalla,
Quadruple cottage at Nivitigalakele,
Carpenter's shed at Dartonfield.

The report was adopted.

(*b*) *Appointment of a Visiting Agent.*—The recommendation that Mr. W. A. Paterson be appointed V. A. was approved.

(*c*) *Hedigalla cart road.*—The recommendation that tenders be called for extension of this road by one mile in two stages of ½ mile each was approved.

(*d*) *Office room at Hedigalla.*—The recommendation that an extra room be added to the proposed Rice and Tool Store at Hedigalla, to serve as an office room, was approved.

(*e*) *Estate Superintendent's application for leave.*—As recommended by the Committee, Mr. G. P. N. de Silva, Estate Superintendent, was granted six weeks leave from August 11. It was left to the Director to arrange for a neighbouring estate superintendent to overlook the estates during this period.

(*f*) *Experimental K. P.*—As recommended by the Committee, S. H. Sahayanesan was appointed Experimental K. P. with effect from August 1, 1947.

(*g*) *Water supply to Conductor's bungalow at Dartonfield.*—As recommended by the Committee, a vote of Rs. 420 was passed to cover the cost of providing a pipe-borne water supply to the Conductor's bungalow at Dartonfield.

The minutes were adopted.

5. **REPORTS AND ACCOUNTS.**

(*a*) *Director's report for the 1st quarter 1947.*—was approved.

(*b*) *Estate accounts January to April, 1947.*—were tabled.

(*c*) *Finance.*—The sale of Rs. 30,000 stock of 3 per cent. National Loan 1953 to provide liquid cash to meet anticipated commitments was approved.

(*d*) *Rent Allowance.*—It was agreed that a minimum rent allowance of Rs. 5 per month should be paid to married officers, as provided in correction slip No. 273 to Financial Regulation 976.

Mr. J. D. Farquharson came into the meeting.

6. **RE-ORGANIZATION OF BOTANICAL-MYCOLOGICAL DEPARTMENT.**

In view of the difficulty of recruiting suitable research officers from abroad at the present time the Director and the Mycologist had submitted proposals for re-organizing the Botanical-Mycological Department by appointing a number of junior officers of the Laboratory Assistant type, thus relieving the present senior officers of a good deal of routine recording work. The present senior officers of the Department could then carry out the programme of work laid down by the Board until 1950 when it would be necessary to appoint a Ceylonese graduate o outstanding ability as Assistant Botanist.

The proposals were approved.

7. OIDIUM LEAF DISEASE.

Col. Young stressed the importance of doing everything possible to eradicate this disease which, he said, appeared to be gaining ground in certain areas. The Director assured the Board that all possible measures were being taken to keep the disease under control ; also that investigations were in progress to ascertain the life cycle of the fungus and to find resistant strains of Hevea.

8. STAFF.

(*a*) *End of contract leave for Botanist and S. H. P. O.*—Noted that the end of contract leave due to these two officers would fall due towards the end of the year. Agreed that the Botanist should have a further month's leave and that his leave should commence in September.

(*b*) *Junior Staff.*—Agreed that the junior staff be paid a special allowance of 10 per cent. of salary in addition to the present dearness allowance.

9. PUBLICATIONS.

Advisory Circular No. 17 was tabled.

The meeting then terminated.

Dartonfield,
Agalawatta, August 29, 1947.

C. D. DE FONSEKA,
Secretary-Accountant.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED JULY 31, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to July 31, 1947			
				Deaths	Recoveries	Balance Ill	No. shot.
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	15	94	94	—	—	—
Colombo Cattle Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	3	31	31	—	—	—
Northern Province	Foot-and-mouth	124	886	86	544	256	—
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	—	41	14	25	2	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	—	901	92	809	—	—
Southern Province	Foot-and-mouth	68	357	2	157	198	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	—	3	3	—	—	—
	Piroplasmosis	19	19	1	—	18	—
	Rabies	—	2	2	—	—	—
	Haemorrhagic Septicaemia	34	34	34	—	—	—
Eastern Province	Foot-and-mouth	—	2797	135	2662	—	—
Province of Uva	Foot-and-mouth	—	2012	70	1933	9	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, September 2, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED AUGUST 31, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to Aug. 31, 1947			
				Deaths	Recoveries	Balance Ill	No. shot.
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	10	104	104	—	—	—
Colombo Cattle Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	—	31	31	—	—	—
Northern Province	Foot-and-mouth	94	980	89	741	150	—
North-Western Province	Rabies	—	1	1	—	—	—
	(Mange goats)	—	41	14	27	—	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	32	933	98	835	—	—
Southern Province	Foot-and-mouth	13	425	4	219	202	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	—	3	3	—	—	—
	Piroplasmosis	—	19	1	18	—	—
	Rabies	—	2	2	—	—	—
	Haemorrhagic Septicaemia	—	34	34	—	—	—
Eastern Province	Foot-and-mouth	—	2797	135	2662	—	—
Province of Uva	Foot-and-mouth	—	2012	70	1942	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, Sept. 4, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED SEPTEMBER 30, 1947.

Province	Disease	Fresh Cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to Sep. 30, 1947. Deaths	Recoveries	Balance Ill	No. shot
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	12	116	116	—	—	—
Colombo Cattle Quarantine Station	Foot-and-month	—	18	—	18	—	—
	Anthrax	—	31	31	—	—	—
Northern Province	Foot-and-mouth	—	980	89	861	30	—
	Rabies	6	6	—	—	—	6
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	—	41	14	27	—	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Province of Sabaragamuwa	Foot-and-mouth	—	933	98	835	—	—
Southern Province	Foot-and-mouth	40	465	5	422	18	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	—	3	3	—	—	—
	Piroplasmosis	—	19	1	18	—	—
	Rabies	—	2	2	—	—	—
	Haemorrhagic Septicaemia	—	34	34	—	—	—
Eastern Province	Foot-and-mouth	—	2797	135	2662	—	—
Province of Uva	Foot-and-mouth	—	2012	70	1942	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, October 23, 1947.

METEOROLOGICAL REPORT, JULY, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	86·4	+1·4	72·9	—0·9	82	98	7·6	12·27	26	— 0·43
Anuradhapura	90·7	—0·1	76·3	+0·4	66	88	5·4	1·17	3	— 0·15
Badulla	87·0	+0.6	64·0	0	68	94	4·7	3·18	8	+ 1·61
Batticaloa	91·0	—1·4	77·0	0	69	82	6·8	0·54	4	— 0·50
Colombo	86·5	+1·8	77·1	0	80	89	7·8	7·05	19	+ 1·56
Diyatalawa	78·1	—0·1	63·1	+0·5	65	79	4·4	3·80	8	+ 1·84
Galle	84·2	+1·5	77·6	+0·8	84	89	5·8	9·39	17	+ 3·05
Hakgala	69·6	+1.4	58·8	+1·4	80	84	7·1	2·26	13	— 4·38
Hambantota	86·8	—0·9	76·8	+0·4	83	91	8·1	0·45	6	— 1·56
Jaffna	86·5	+0·4	80·2	+0·4	80	82	5·5	0·29	2	— 0·26
Kandy	85·2	+2.5	70·8	+0·2	76	87	7·2	3·91	22	— 3·41
Kurunegala	86·7	+0·3	75·5	+0·3	77	86	7·3	8·02	23	+ 4·14
Lunuwila	85·5	+0·3	77·0	0	82	91	7·2	6·83	19	+ 2·81
Mannar	87·4	—0·1	79·7	+0·6	78	85	6·8	1·33	2	+ 0·98
Nuwara Eliya	66·9	+1.6	55·0	+0·2	80	85	7·9	4·01	18	— 7·01
Puttalam	87·1	+1·2	79·1	+0·8	76	85	6·3	0·14	4	— 0·85
Ratnapura	87·4	+0·8	74·5	—0·1	78	90	6·7	12·60	24	— 0·17
Talawakele	73·2	+3.2	59·6	+0·1	84	94	7·9	5·01	23	— 8·29
Trincomalee	91·8	—0·6	77·9	—0·2	72	82	5·8	2·48	3	+ 0·75

Rainfall in July was irregularly distributed on both sides of average, deficits predominating. Largest deficits occurred on the south-western slopes of the hills, where the monthly totals at several stations were below average by more than 10 inches. For these parts July has been the fourth successive month with deficient rain. The largest deficits were 15·40 inches at Blair Athol estate, 14·24 inches at Abergeldie estate, 13·39 inches at Hatton and 13·05 inches at Luccombe estate.

Excesses were generally small. The larger excesses were found in places in the western low-country and near Badulla, outstanding figures being 6·94 inches at Franklands estate and 6·62 inches at Ruwanwella.

Rainfall was heaviest on the south-western slopes of the hills and the neighbouring low-country. Blackwater estate recorded 23·18 inches, Watawala 22·87 inches, Kellie estate 20·93 inches and Norton Bridge 20·17 inches. Outside the south-west quarter rainfall was generally below 2 inches, though in a small area to the east of Badulla a few stations had totals of over 5 inches. A few stations in the north and east recorded no rain at all.

No daily falls of 5 inches or more were reported in July.

Temperatures were slightly above average. The highest recorded shade temperature was 98·0° at Anuradhapura on the 4th, while the lowest air temperature was 45·8° at Nuwara Eliya, also on the 4th. Humidities were mainly above average. Cloud amounts were in deficit. Winds were south-westerly.

D. T. E. DASSANAYAKE,
Superintendent, Observatory.

METEOROLOGICAL REPORT, AUGUST, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	84·3	—0·7	73·1	—0·5	82	98	8·0	24·04	21	+13·00
Anuradhapura	89·7	—1·7	75·9	+0·4	70	88	6·4	1·65	8	+ 0·03
Badulla	83·7	—2·5	65·4	+1·0	75	97	6·2	5·55	12	+ 2·35
Batticaloa	90·6	+0·1	76·8	+0·3	70	82	7·6	0·96	5	— 0·99
Colombo	84·4	—0·4	76·7	—0·2	81	88	9·0	9·23	19	+ 5·20
Diyatalawa	75·8	—2·2	62·5	+0·8	71	86	6·0	9·10	11	+ 5·98
Galle	83·4	+0·8	76·4	—0·3	85	88	6·8	10·21	19	+ 4·07
Hakgala	67·4	—2·0	58·1	+0·9	85	86	8·0	17·72	16	+12·57
Hambantota	87·4	+0·6	76·2	+0·2	77	86	9·0	3·68	9	+ 2·24
Jaffna	86·9	+1·0	80·2	+1·1	80	82	6·4	0·31	3	— 0·80
Kandy	81·5	—1·7	70·5	+0·5	81	90	8·0	28·41	21	+22·68
Kurunegala	84·5	—2·5	75·1	+0·3	80	88	8·4	12·18	19	+ 8·56
Lunuwila	83·8	—1·4	76·6	—0·2	82	88	8·6	5·02	18	+ 1·83
Mannar	87·4	0	79·3	+0·7	78	82	7·4	1·23	6	+ 0·57
Nuwara Eliya	64·0	—2·2	54·9	+0·7	86	91	9·4	26·68	21	+19·17
Puttalam	86·1	—0·2	78·1	+0·2	77	84	6·8	0·39	7	— 0·26
Ratnapura	84·5	—2·2	74·6	+0·4	78	86	7·8	32·74	23	+21·35
Talawakele	68·8	—2·3	59·5	+0·4	91	94	9·0	20·81	28	+10·73
Trincomalee	90·1	—2·0	77·5	+0·3	73	84	8·5	1·81	3	— 1·80

The outstanding feature of the weather in August was the unprecedentedly heavy rains that occured about the middle of the month in the south-western quarter of the Island, particularly in the hill-country. Kandy, with an average August rainfall of 5·73 inches, totalled 28·41 inches last month, its previous highest August rainfall during 77 years of observations being only 17·07 inches in 1931. Among the other numerous stations that broke their previous August records may be mentioned, Peradeniya Gardens 31·99 inches (previous highest, 19·18 inches in 1931 ; 64 years), Waragalande estate, Madulkelle, 50·41 inches (previous highest, 14·30 inches in 1931 ; 44 years), South Wanaraja estate, Dikoya, 49·72 inches (previous highest, 31·01 inches in 1931 ; 62 years), Luccombe estate, Maskeliya, 58·76 inches (previous highest, 49·57 inches in 1931 ; 45 years), and Hatton 53·50 inches (previous highest, 41·28 inches in 1931 ; 51 years).

A large number of stations on the western slopes of the hills received over 50 inches during August, three stations recording over 60 inches, Blackwater estate 63·45 inches, Watawala 62·35 inches, and Norton Bridge 61·27 inches. Other noteworthy totals include Kenilworth 58·68 inches and Kellie 58·60 inches.

In the south-western quarter of the Island, excesses ranged from 5–10 inches in the low-country to over 30 inches among and near the hills. The largest excesses include 44·38 inches at Waragalande estate, 41·55 inches at Kellie estate and 40·13 inches at Blackwater estate. In the north and east of the Island rainfall departures from normal were generally under 2 inches.

During the first week of the month only light or moderate rain was experienced. With a steepening of the south-westerly pressure gradient about the 8th, there was a marked increase in rainfall. On the 14th and 15th, more particularly on the 14th, very heavy rain was experienced throughout the south-west quarter, the larger falls occurring among the hills. The rain was accompanied by severe squally weather. The recording anemometer at the Colombo Pilot Station frequently registered westerly winds of gale force (38 m/h and above) during the period 14th to 16th. The weather moderated thereafter, and from the 18th till the end of the month only light rainfall occurred.

There were more than 290 daily falls of 5 inches and over reported during August, of which 90 falls were over 10 inches. Of these, nearly half occurred on the 14th. The largest daily falls were 18·70 inches at Oonoogaloya, 18·00 inches at Luccombe, 17·38 inches at Kandy, and 16·68 inches at Dunsinane, all on the 14th. These figures broke the previous highest daily falls on record for the respective stations. At Kandy during 77 years of observations the previous largest daily fall was 8·95 inches on May 8, 1883, while at Dunsinane estate with 61 years of observations the previous record was 10·93 inches on July 2, 1892. At Oonoogaloya, 18·70 inches on the 14th, was followed by a further 16·75 inches on the 15th. The two falls together make up 35·45 inches on two consecutive days. Although this is not a record for the Island (the record is Rasagalla estate's 54·39 inches for 16th and 17th May, 1940), it constitutes one of the largest 2-day falls. Luccombe with 13·42 inches on the 15th collected 31·42 inches for the two days.

Temperatures were generally below average by day, and slightly above average by night. The highest recorded shade temperature was 97·8° at Batticaloa on the 31st, while the lowest air temperature was 47·7° at Nuwara Eliya on the 5th. Humidities were above average, and cloud amounts in excess. Winds were south-westerly.

D. T. E. DASSANAYAKE,
Superintendent, Observatory.

METEOROLOGICAL REPORT, SEPTEMBER, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	85·4	—0·1	72·5	—0·7	82	98	7·5	12·86	17	—2·50
Anuradhapura	90·8	—0·8	75·4	+0·4	65	88	7·5	1·30	3	—2·46
Badulla	84·6	—1·1	64·2	0	70	94	5·6	0·66	4	—3·83
Batticaloa	90·8	+1·1	76·3	+0·2	72	82	7·4	3·95	8	+1·56
Colombo	84·2	—1·1	76·1	—0·5	80	88	8·6	7·31	13	+0·47
Diyatalawa	77·0	—0·9	61·7	+0·8	64	81	5·5	0·72	4	—3·69
Galle	82·7	—0·2	76·2	—0·6	86	91	5·2	2·90	12	—5·91
Hakgala	67·4	—2.7	58·4	+1·7	86	83	7·2	3·19	15	—3·47
Hambantota	87·3	+0·7	75·9	—0·2	79	88	8·9	0·54	3	—2·22
Jaffna	85·5	—0·7	79·4	+0·3	79	82	6·4	7·09	5	+4·56
Kandy	82·8	—1·6	69·4	+0·2	78	87	7·8	4·98	21	—1·46
Kurunegala	85·7	—2·0	74·1	—0·2	77	88	7·4	3·36	19	—2·19
Lunuwila	84·3	—1·7	76·3	+0·1	82	91	8·0	3·36	13	—1·94
Mannar	86·7	—1·1	78·8	+0·1	77	84	7·0	0·50	3	—0·74
Nuwara Eliya	64·5	—2·4	54·6	+1·5	80	82	9·0	5·16	18	—3·08
Puttalam	86·4	—0·4	78·1	+0·3	75	84	6·0	0·15	6	—1·43
Ratnapura	85·9	—1·2	73·7	+0·2	76	88	8·3	15·01	20	+0·49
Talawakele	70·4	—1·9	58·9	+0·6	86	91	8·8	8·67	22	—1·08
Trincomalee	90·9	—1·0	77·0	0	70	84	9·0	6·97	4	+3·54

Rainfall in September was below normal over a large portion of the Island, deficits generally ranging from 0 to 2 or 2 to 5 inches. Larger deficits, of the order of 5 to 10 inches, occurred chiefly in Galle District, the highest being 7·42 inches at Hiniduma, 7·20 inches at Udugama and 6·43 inches at Labuduwa.

Excesses were found mainly on the south-western slopes of the hills and the neighbouring low-country. Blackwater estate recording 10·48 inches above average, Ruwanwella 8·79 inches and Kellie estate 8·18 inches. There were also a few appreciable excesses along the east coast.

Rainfall was heaviest on the south-western slopes of the hills, where Blackwater estate recorded a total of 33·57 inches for the month, Norton Bridge 31·03 inches, Watawala 30·48 inches and Ingoya estate 29·98 inches. There was a general decrease in rainfall outside this area. In the north and the east the monthly totals were generally below 2 inches. A number of stations in this region recorded no rain at all for the month.

There were no daily falls of five inches or over during September.

The weather during the month was mainly of the south-west monsoonal type, with occasional local thunderstorm activity in the north and east. Very little rain fell during the period 1st to 6th, and the last four days. Moderate rain was experienced during the rest of the month, with heavier and more extensive falls on the 10th, 21st and 22nd.

Temperatures were below average by day, and generally a little above average by night. The highest recorded shade temperature was 98·8° at Batticaloa on the 1st, while the lowest air temperature was 47·0° at Nuwara Eliya on the 30th. Humidities were mostly above average, and cloud amounts were in excess. Winds were south-westerly.

D. T. E. DASSANAYAKE,
Superintendent, Observatory.

The

Tropical Agriculturist

OCTOBER TO DECEMBER, 1947

EDITORIAL

THE COCONUT RESEARCH SCHEME

THE entire coconut industry will learn with satisfaction that the Minister for Agriculture and Lands has agreed to support the proposals for reorganization of the Coconut Research Scheme. This means that the Scheme will have at its disposal a capital sum of Rs. 400,000 for permanent improvements and Rs. 150,000 every year for its recurrent expenditure. The former is to be an outright grant by the Government and the latter is to be provided by an increased cess. The measure has not yet been sanctioned by the legislature, but it can confidently be anticipated that the Minister's wish will be endorsed by the new Parliament. In the meantime, the Minister has seen to it that the funds immediately required are placed at the disposal of the Scheme, for a time at least, from other sources. This farseeing measure has made it possible for the new proposals to be given effect to without delay.

The capital expenditure is to be distributed among—

	Rs.
(*a*) Purchase of land for demonstration sites ..	20,000
(*b*) Staff bungalows	60,000
(*c*) Equipment for the proposed field laboratory at Ratmalagara and of the laboratory at Bandirippuwa	40,000
(*d*) Factory	250,000

The recurrent expenditure goes up too. The average for the years 1941–43 is Rs. 118,000. The estimated average over the 10 years following 1945 is Rs. 151,000. The corresponding averages for salaries alone work out at Rs. 62,700 and Rs. 103,800, respectively.

The cess that will ultimately have to be collected is very small. The total exports during the next 10 years are estimated at 670,000,000 nuts per year. The average recurrent expenditure will at its maximum not exceed Rs. 227,000. The cess will therefore be somewhere in the region

of 33 cents per 1,000 nuts. No one can say that this is a severe drain on the industry especially with the present prices and the possibility of a fairly good market up to about 1960. But the smallness of the cess should not keep us from inquiring what the benefits are that the industry is likely to get by this additional expenditure.

There can be no gainsaying the fact that, rightly or wrongly, the industry has had a vague feeling that the Research Scheme has not been "delivering the goods". Of late, this vague feeling has become articulate and has been a source of discomfort both to the Board of Management and to the executive and technical staff. To this, the reply of the executive staff has been that the industry was asking too much of the staff and that, in any event, it could do no more with the limited facilities at its disposal.

It is unnecessary here to go into the rights and wrongs of this question. Suffice it to say that, if the Scheme had suffered by lack of staff, the present proposals remove that disability. The research staff is to be strengthened by the addition of four assistants. The laboratories are to be fully re-equipped on the lines proposed by the research staff. The technological side, which has hitherto been the target of most of the criticism, is to be given equipment comprising three desiccators, two oil expellers and fibre machinery. Side by side with these improvements, the research officers have been relieved of administrative routine by the appointment of a Secretary Accountant. It is sincerely to be hoped that these improvements will pave the way for a harmonious development and evolution of a scheme of research suited to the needs of the country. Needless to say, no improvement will result if the good intentions of the Board of Management evoke only a perfunctory response from the members of the staff. Extra funds and extra buildings are alone insufficient to produce results. It has frequently been said that money coarsens what is fine and worsens what is coarse. Let us sincerely hope that this will not be the effect of money on the corporate mind of the Scheme. It is a significant fact that at no time has the Board of Management refused an increase of technical staff when this has been applied for. The plea of inadequate staff made its appearance only when complaints of inadequate output became vocal. Executive officers especially technical officers, are in a very strong position to get their requirements of assistants—if they would but ask. For it is not in the best interests of the employer to deny help to a sincere and earnest worker. If, therefore, a research officer asks for help and does not get it, he would do well to look within. The greatness of a research officer's resources, both in men and material, is in direct proportion to his personal greatness.

The coconut industry has held so far a very important place in the economy of the Island. Everything points to its maintaining that position for many years to come. It has been the practice to call coconuts the Consols of the East. The depression of 1931 and the emergence of other oilseeds in the world market disturbed very greatly the sense of security in the crop. But at the back of everybody's mind was the feeling that the day of the industry could not possibly have passed and that the multiplicity of the uses to which its several parts can be put would always ensure its prominence in the Island's trade. Even in the dark days of the war, when the nation's larder was at a very low ebb and food was distributed each day with hardly

any prospect of replenishment on the morrow, there were numbers in this country who used to say "Failing everything else, there is always the coconut". As a matter of fact, people are still accustomed to speak of the success of food drives, manioc, &c., as having saved the country, but no one has calmly worked out how much that useful old friend, the coconut contributed towards the tiding over of those critical times. The food potentialities of those million acres, if nothing else, must have lent courage to the feeble-hearted. Such is the strong faith of the country in the crop that the Coconut Research Scheme has been called upon to handle.

It is clear, however, that the coconut industry will have at best a very nebulous future if it endeavours to flourish merely as an article of export. There has to be a change of emphasis in its utility value. It seems inevitable that the crop should gradually assume importance as an article of internal consumption, even more so than it does at present. With the growing consciousness that our nutritional standards must be considerably improved, the demand for milk will continue progressively to increase. The problem of adequate feeding stuffs for our milch cattle will thus, sooner or later, assume considerable prominence. The fat requirements of the country have been met to a great extent by the use of the coconut kernel; it may truthfully be said that the absence to any significant extent of milk in the national dietary is due to the popularity of the coconut. But milk has other advantages besides fat content from a nutritional standpoint and the use of coconut poonac as a stock feed is likely to be as important as the use of the coconut kernel as an article of human food. It is even likely that coconut poonac will displace other coconut products in the order of importance and that sooner or later even coconut oil will be regarded as a bye-product of the poonac industry. Methods of improving the nutritional value of poonac should prove a useful line of applied research. The oil content in the coconut cake has to be reduced and the calcium content increased, if possible, by a suitable alteration in manuring systems. Further, more uses should be found for coconut oil within this country than at present. This is obviously a direction in which the technological experts should endeavour to see the possibilities rather than the impossibilities. It is a truism that the utilization of any article fit for human consumption for any other purpose is an unskilful use of our raw products. In the same way, to send out of the country any article that can be readily adapted for such usage while importing materials for the same purposes is an equally unskilful, wasteful and illiberal process. By this means, the dangers of a system of trade that lends itself to unpredictable fluctuations can be mitigated.

The national importance of the work to which the Coconut Research Scheme is dedicated is therefore clear. The general public is aware of this and will willingly support it in its undertakings. But public opinion is a fickle thing and it is left to those concerned to see that the proffered favour does not change into disgust.

SOIL STRUCTURE IN RELATION TO SOIL EROSION

D. E. V. KOCH, Ph.D., B.Sc. (Lond.), D.I.C., F.R.I.C.
ACTING CHEMIST, DEPARTMENT OF AGRICULTURE

SUMMARY

THE part played by soil structure in relation to soil-erosion is discussed.

The primary aim in anti-erosion measures is the reduction and if possible the prevention of surface run off of rain water, which carries with it the valuable surface soil.

The physico-chemical processes, which govern the loss of soil and the principles underlying aggregation or crumb—formation in soils are discussed.

The ameliorative measures that should be carried out on (*a*) light and (*b*) heavy soils with a view to decreasing their erodibility are dealt with from the practical standpoint.

The soil of a country is one of its most precious possessions. Accordingly, the first condition which must be fulfilled by any system of agriculture is that every effort should be made to conserve it.

In any discussion on the methods of controlling or checking soil erosion, it is usual for one to lay very great emphasis on the importance of a good ground cover, &c., and the control of the movement of free surface water but to neglect or to a greater or less extent overlook the essential factor of the amelioration of the soil so that it attains its maximum absorptive capacity and its minimum erodibility.

The primary aim in anti-erosion measures must be the prevention of surface run off of water during periods of normal rainfall and the reduction of such run off to the barest minimum during periods of high to exceptionally high intensity, which is by no means infrequent in a tropical country like Ceylon. This object can only be effectively carried out by obtaining the greatest absorption of the rain water by the soil, and the more the water absorbed, the less there is to run down the slope carrying surface soil with it. Surface soil contains the greatest part of the mineral nutrients and practically all the organic matter. Moreover, it is also the centre of activity of micro-organisms that bring certain nutrient materials into a condition assimilable by plants. Of the soil constituents, it is the most important clay particles, which are readily lost, as they are held in suspension in water for long periods, owing to their very minute size. It has to be mentioned that clay soils erode more than sandy soils at low gradients, but less at gradients above 15 per cent. H. H. Bennett holds the view that soils having Si/O_2 R_2/O_3 (molecular) ratios greater than 2 are generally plastic and erodible, while those

with lower ratios are friable and non-erodible. Although this simple generalization does not hold widely, it is one of the single value soil properties which has been found to be related to the rate of erosion in Ceylon soils. Whatever be the nature of the soil, it is clear that any loss of surface soil, and particularly of the clay fraction from it, if allowed to continue unchecked will so reduce the fertility of a soil (through internal erosion) that its cultivation will ultimately become unprofitable.

From the physico-chemical standpoint the problem of erosion has to be tackled in two ways, which are, however, not entirely distinct. The first is by suitable treatment of the soil with a view to increasing not only its absorptive capacity for water but also its rate of imbibition of water, since the latter has an important bearing on the amount of run off. The second method of reducing losses by erosion is by promoting the clay particles to form aggregates, called crumbs, and thereby improving the structure of the soil. The two favourable conditions desired in the first instance can be secured by the same means, viz., by a combination of lime and organic manure treatments. It is well known that turning under the vegetation of leguminous and other green manure crops not only improves the fertility of the land but also is one of the principal means of soil conservation. Apart from these, the soil building crops include most of the grasses. Both these classes of soil conserving crops are benefited by the application of lime, because they grow best and produce most vegetation when the soil is kept nearly neutral in reaction. Organic matter—even in an unhumified condition—has a high absorptive capacity for water (and as we shall see later also promotes crumb formation when humified), whilst the lime improves the physical condition of the soil by flocculating the clay and thereby bringing about better aeration and drainage in the soil.

The second and perhaps the more important measure in combating soil erosion is the production of a good structure in the soil by the promotion of soil aggregates or crumbs which have a far less tendency than individual particles to be carried in suspension in free surface water.

Before proceeding to deal with the means available for promoting crumb formation it is deemed necessary to deal at some length with the principles underlying aggregation.

When a wet soil gradually dries up the clay particles approach one another closely and form aggregates called crumbs. This phenomenon is said to be due to the negative clay micelles as well their cations (positively charged exchangeable ions) causing the bipolar water molecules to undergo orientation, the extent of which depends on the intensity of the charge of the cations and also of that of the clay micelles. With further drying the cations attract water molecules already orientated by two or more different clay particles and a system is built up which becomes more and more rigid and finally yields " dry " crumbs. If such a system is well shaken with water there is a break down, but once again it is reformed on drying. A crumb formed by quick drying is usually small. The mechanical strength of the crumb, however, depends largely on the base exchange capacity of the clay. Where this is high the soil produces crumbs, the stability of which is uneffected on rewetting and this is specially so in the presence of calcium ions. Although electrolytes help in crumb formation, the crumbs formed remain more stable

in their absence. It is noteworthy that good crumbs have a dense arrangement and are rather rigid. When the crumbs contain small amounts of silt and sand the resulting structure is favourable for cultivation purposes.

In the presence of organic matter the crumbs formed are very stable owing to soluble alkaline earth salts of some of the complex humic acids precipitating on the soil particles and causing them to adhere. Thus, in the formation of crumbs, silt and sand particles are caught up with the clay and humus, and, if sufficient of the latter two are present, the whole soil can take on a crumb structure. These crumbs in their turn can unite to form aggregates of various sizes. On light soils owing to the insufficiency of colloids, the crumbs remain loose and separate, while on heavy soils they unite into hard steely lumps or clods, which are broken down only with difficulty. It is the intermediate state, described as " granular ", which is regarded as the most perfect development of structure and which is least liable to erosion. The optimum size of these soil granules should be about 2 mm. and not less than ·25 mm. in diameter. Smaller crumbs merely block the coarser pores and restrict drainage without appreciably increasing the water-holding capacity of the soil. Moreover, a good soil structure should be stable against the pulverising effect of wind and the shattering action of rain. From the soil standpoint a stable crumb structure is undoubtedly a valuable physical property. It is one of the most important factors in preventing erosion.

No special attention has been paid in Ceylon to the effect of artificial fertilizers on soil erosion. Mention, however, must be made that repeated applications of nitrate of soda will result in deterioration in the physical structure of soils. This will be markedly so in the dry zone soils as this fertilizer has the tendency to deflocculate the clay causing its dispersion and movement into the sub-soil. On the other hand, the long continued use of sulphate of ammonia, whilst making soils more acid, has practically no effect on their physical structure. The immediato action of applying potassic fertilizers is the same as that of other neutral salts, namely, to intensify soil acidity, but the ultimate effect, especially in the case of sulphate of potash applied over a period of years, is to conserve the exchangeable calcium in the surface soil and thereby to promote soil aggregation. Phosphatic fertilizers either reduce the acidity of soils or have practically no effect on soil reaction, and this is true even of superphosphate, which is an acid phosphate. Thus, in many instances the use of artificial fertilizers may result in the building up of soils to withstand erosion.

It now remains to detail the principal methods by which soil aggregation and consequently soil erosion can be controlled. For the purpose of this discussion it is convenient to take the two extreme categories of the physical classification of soils, viz., (*a*) light soils and (*b*) heavy soils.

(*a*) *Light Soils.*—Firstly, the basic calcium ion associated preferably with phosphate should be applied, *e.g.*, basic slag. Secondly, on account of the low clay content, the insufficiency of colloids has to be made good by liberal and frequent dressings of bulky organic matter. The ploughing in of green leguminous crops is recommended as, in general, it is more efficient than the incorporation of cattle manure, because plant residues are rich in " binding material ". Thirdly, it is known that aggregation can be controlled in some measure by suitable cultivation. This process depends both on the

moisture content of the soil and the degree of compression to which the soil is subjected. It is therefore necessary that all light soils should be cultivated in a wet condition (near the sticky point moisture level as aggregation is then greatest) by means of an implement such as a mould board plough.

(*b*) *Heavy Soils.*—Firstly, excess acidity in these soils must be neutralized by means of lime, disked in. In those cases where the soil is not unduly acid, a small amount of lime should nevertheless be applied to increase the carrying capacity of any pasture on it. Secondly, although heavy soils need less organic matter than the previous class, bulky organics should, nevertheless, be given. As an alternative it is a good plan to put the land down to grass, especially of the perennial type for a period of at least two years. Thirdly, the cultivation operations should be *commenced* with an implement that causes least compaction. Tillage is best carried out after the soil has been allowed to dry completely and is remoistened slightly. In other words the soil should be worked far below its sticky point. Saline soils must first be reclaimed and drained free of salts before any attempt at building up structure is attempted.

Finally, it has to be emphasized that profitable money crops and nutritious food crops can only be produced economically by the production of a good structure in the soil, which by itself can considerably help towards minimizing the loss of the most valuable soil constituents brought about by erosion.

AGRICULTURE AND EROSION IN CEYLON

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SUMMARY

THE old systems of land use in Ceylon conformed to a royal edict which made soil and water conservation basic to agriculture. Paddy cultivation alternated with a grass fallow. Vegetation on high lands afforded protection against soil and water losses. Chenas not disturbed by stray cattle regained their fertility quickly. Alienation of land and the keeping of large herds of cattle have increased pressure on the land which is now cultivated without sufficient protection against wind and rain. Overhead shade and ground covers supplemented by soil conserving earthworks are the usual measures against erosion. Soil conservation is not generally practised on small holdings. Education and legislation together with subsidies are suggested.

Research is needed to test out the efficacy of methods already adapted here and those suggested elsewhere. The weakness of the investigations already afoot in the dry zone is that they do not make water conservation basic to agronomic practices. This is recommended on a unit-control basis for each watershed area. The desire for bigger returns from lands has led to faulty land use and erosion. A new orientation in which plant, animal and soil work in harmony in a compact of mutual advantage is the remedy. Even trade has to be so modified that only processed products are sent away. It is also possible that middle class holdings worked on co-operative lines will be the order in future.

INTRODUCTORY

Parakrama Bahu the Great is said to have decreed "Let not a drop of water leave the land until it has served you to the fullest". This edict has hitherto been interpreted as referring to the storage and use of rain water in tanks for irrigation purposes. All rain water cannot be used effectively unless water conservation is practised not only in tanks, ponds and wells but also in the soil itself for plant growth. Such water storage is efficient only in proportion to increased infiltration and reduced run-off and this means reduced erosion. The royal decree thus made soil conservation basic to agriculture in ancient times.

ANCIENT SYSTEMS

This fact is borne out not only by the terraced paddy fields and such irrigation channels as the Yoda-Ela so graded that water is delivered at non-erosive velocities but also by the system of land use still practised in many parts of Ceylon. The homesteads grouped on the high lands carry a variety of crops which supply the assortment of curries. Coconut, jak and

fruit trees, shrubs, betel vine and vegetables grown in sunken beds and even leafy vegetables were common. Overhead canopy, ground cover and a well-tilled soil secured increased infiltration and reduced run-off. Even the thickly thatched roof under the dense foliage played its part.

Paddy was grown in the valleys. In the wet zone, streams, normally fed from underground springs supplemented by run-off from highlands, provided irrigation. Usually one crop of paddy was grown each year in each tract. Paddy was alternated with a grass fallow which provided the grazing for cattle, fed on straw and poonac and restricted in numbers to working animals by a religion which forbade killing. The " healing benediction " of a grass, not over-grazed, helped by insects and micro-organisms made the cultivation of paddy without fertilizers possible.

In the dry zone, where permanent cultivation is practicable only round the homesteads, highland cultivation was restricted to the so very much condemned system of *chenaing*. Jacks and Whyte—" The Rape of the Earth " (1939), page 103, say, " It must be admitted that no agricultural system except shifting cultivation has yet been devised that will ensure lasting stability and fertility to tropical forest soils under human management ". Even here, our forbears had adopted the best system of cultivating their high lands in the dry zone.

PRESENT SYSTEMS

In the wet zone the expropriation of lands by capitalists has upset the village economy. High lands do not now provide sufficient pasturage for village cattle with the result that paddy fields are over-grazed in the fallow season which is often very short. Thus, fields with their productive capacity already lowered are subject to a further danger when these fields are worked during the heavy rains which carry away the finest and most valuable particles of soil normally held in suspension. In the dry zone, conditions were not so bad till the recent food production drive which led to the cultivation of paddy lands in and out of season.

Today, even chena cultivation suffers. Villagers in the dry zone whose money crops are restricted to a few acres of chena sown with kurakkan[1], chillies[2], gingelly[3] and vegetables supplement their income by keeping large herds of cattle which roam about the jungles. An abandoned chena with young grass and sprouting jungle growth is an attractive pasture for roaming cattle. The growth of the jungle is retarded and the land is for the greater part bared of all vegetation and sheet erosion results. We, thus have very poor scrub in place of land in which normally the A—horizon should have been rebuilt in a few years.

Few measures have been adopted against erosion in such plantation crops as tea, rubber and coconut. And the efficacy of the measures usually advocated has not been worked out. In rubber, covers are the most popular form of anti-erosion measures. The canopy provided by the closely planted cocoa, the leaves of which are of the drip-tip variety, and the mulch the shed leaves form are an excellent protection against soil loss through wind or rain even on steep lands in the drier parts of Ceylon.

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[1] Eleusine coracana Gaertn.
[2] Capsicum annuum Linn.
[3] Sesamum indicum Linn.

FACTORS FAVOURING EROSION

In Ceylon there is a number of circumstances which favour erosion. Most lands in the wet zone are hilly and the greater proportion are steep. Thus, both the dispersive effect of the rain on the soil particles and the velocity of run-off are increased. Except in the dry zone, which is largely at present still in jungle, most of our soils are shallow, the A—horizon being a matter of inches. This absence of organic matter reduces infiltration, restricts crumb formation and increases erodibility.

The dry weather is usually succeeded by a heavy down-pour of shattering intensity which easily displaces the particles from a parched soil with no body. These particles are carried away in uncontrolled sheets and streams over lands in most cases bared of vegetation through over-grazing. Matters are worsened by the fact that the drought has slowed down microbial activity and crumb formation. These conditions, repeated from year to year, increase soil deterioration in geometrical proportion with the lapse of time. The absence of drains and live hedges for dividing large blocks of a land gives the flow of water unrestrained scope for sheet erosion. Badly graded roads with no drains induce gullying.

Winds are strongest in the dry periods. Danger from wind erosion is greatest when a prolonged drought bakes a soil which disintegrates to a fine dust with alternate heating by day and cooling by night. Unrestricted cattle movement increases the danger. The vegetation one sees in gutters, on roofs, in the fork of nearly every tree, and even on rocks is an indication that the finest and the most valuable soil particles have been deposited there. Wind erosion gets free play on paddy fields and chenas in large tracts with no belts of protective vegetation. The burning of patanas is another practice which contributes to soil losses both by rain and wind.

FACTORS AGAINST EROSION

A saving feature against erosion in Ceylon is the readiness with which any bared land is clothed by nature with vegetation. Weeds, the despair of all tillers of the soil be they estate superintendent or the more humble peasant proprietor, are nature's safeguards against waste. Even road-surfaces, which to all appearances have been depleted of organic matter, have their own flora made up largely of dwarfed and early-maturing grasses and herbs. Where the subsoil has been exposed it is not long before the lower orders of plant life make their appearance. This plant life is assisted by insects, specially ants, and earthworms. Vegetation is always striving towards a better soil with more organic matter and greater microbial activity.

SOIL CONSERVATION MEASURES (I) COVER

I leave the detailed discussion of soil conservation measures for plantation crops to those more familiar with the subject. Rubber and, to a less extent, coconut, provide protection in their overhead canopy. With tea considerations of labour militate against controlled overhead shade. Ground cover which is popular with rubber and coconut is also a difficulty with tea. Grass suitably treated and properly managed can serve a dual purpose in coconut. For rubber a variety of covers either as a mixture or in succession

would appear to be ideal. The indications are that not only the weather but also the growth of a cover changes the p.H. and p.F. of the soil with the result that the same species cannot be grown continuously.

(II) TILLAGE

Tillage operations, the main purpose of which is the incorporation of organic matter and the building of soil structure, should supplement covers. Tillage also affects the p.H. and p.F. of the soil and this explains the succession of cover crops which one notices on land which previously carried a number of species simultaneously. Bennet, in his latest book on Soil Conservation records a variation in erosion from a fraction of a ton to 150 tons or more per acre annually in a given locality depending on cultural treatment. In America, crop residues as a surface mulch are becoming popular as they intercept and disperse raindrops, prevent the clogging of pores and surface compaction or crusting of surface soil. The surface run off and evaporation are less than when crop residues are incorporated in the soil.

(III) MECHANICAL MEANS

All agronomic measures must be supplemented by mechanical ones devised to either retain all the rain water on the land or to lead it away at non-erosive velocities after giving the water sufficient time to percolate into the lower strata. A critical analysis is needed of all the methods employed and an evaluation required in terms of practical use and limitations under various conditions. A more general use of live hedges above drains to free the water from all soil in suspension appears to be a very desirable added protection. These hedges also serve as foci for bacterial activity.

(IV) RUN-OFF

The disposal of run-off is another matter that receives little attention. At present it flows *via* a road drain to a stream or channel. If no visible damage is done, run-off receives no further attention. Where the run-off flows into village lands usually paddy fields, no notice is taken unless a silt load is deposited somewhere. This overlooks the very serious though not so easily noticed danger of sheet erosion. This is a matter calling for urgent attention on a unit-control basis for each watershed. A study is needed of suitable structures, channels, culverts, terrace outlets, &c. Gully healing and control are another matter for study specially where uncontrolled access is provided to streams, rivers and tanks.

SMALL HOLDINGS

Small holdings present a number of problems. Co-ordinated schemes for leading all run-off to a common outlet, retirement of unsuitable lands from cultivation, expenditure on soil conservation being beyond the means of the owner who therefore neglects to take any precautions, drip from the roof leading to gullying are but a few. Cattle, which are today an indispensable adjunct to the villagers' economy complicate matters further. Communal grazing grounds are not easy to provide in the wet zone, and their administration has proved a headache to many a well-intentioned public welfare worker. In the dry zone the answer appears to be simpler.

EDUCATION

Ignorance is the one great handicap to soil conservation and only education can overcome the hindrance. Education must start with the children by the introduction of soil conservation subject matter in the ordinary curriculum. Soil conservation habits must be inculcated through school garden practices. Grown-ups must also be made erosion-conscious and their intelligence must be appealed to specially in regard to the nature and importance of natural resources in terms of individual and national life. It is only then that the impetus to act can be found.

LEGISLATION

Legislation must supplement education and be specially directed towards the protection of the weaker members of society. The aims of any contemplated legislation should include (i) preservation and improvement of soil fertility. (ii) the reduction of waste of soil resources, (iii) the protection of all waterways, (iv) the conservation of water supplies by controlling run-off and (v) flood control.

FURTHER TRIALS NEEDED

There can be no simple and single cure-all for erosion. Every bit of land presents its own problems and on no land can any single measure be relied on to work. Suitable measures must supplement one another. No erosion control can succeed unless it takes into consideration all factors such as soil characteristics, slope, erodibility, cover and climate. So far measures in Ceylon have been worked out from those practised in other countries on the basis of error and elimination. We do not have sufficient recorded experience. If we are to deal successfully with erosion and avoid waste of rainfall we must have a continuing programme of research to improve the old methods, and discover new ones, which should be within the competence of the farmers' purse and intelligence.

RESEARCH

Research is also needed for checking up on the efficiency of such untested methods as stubble mulching and terrace channels with variable grades which are recommended elsewhere, and more especially for checking up on the fundamental problems of land use. In ancient times a system of subsistence farming ensured that soil conservation was basic to agriculture. Growing crops for exports has considerably altered the country's economy and a system of defensive soil husbandry has still to be worked out. Research has yet to evolve ways and means of overcoming the one great drawback of the chena, viz. : " the low and static standard of living ".

The cultivation of the dry zone is a vast and complex problem which calls for simultaneous research on several such aspects as the disposal of rain water, soil characteristics, water requirements of plants, &c. In attempting to solve some of the problems we have come up against others. The soils are so dry that no cultivation by bullock-drawn implements can be started till the first showers fall late in September. This does not leave much time for preparing the land for such crops as kurakkan and cotton. Outbreaks of malaria synchronize with the onset of rains and this adds to the handicaps.

Tractor cultivation has been suggested for breaking up the soil well in advance of the rains. Leaving the land bare and exposed to the sun is very destructive of organic matter in the soil and this ruins soil structure. The strong winds at this time and the rains which come later both carry away the finer and more valuable soil particles. Land so treated does not differ much from subsoil in appearance. Heavy dressings of farmyard or compost manures may reduce the danger but a scarcity of water sets a limit to the amount of compost that can be turned out.

The application of fertilizers induces a heavy weed-fall the eradication of which either by hand hoes or rotary tillers tends to disintegrate soil still further. Row crops when grown accelerate erosion. Chillies[1], cotton[2] and maize[3] are the worst crops. Kurakkan[4] sown broadcast grows fast and provides a good ground cover. The residue of kurakkan is also a very valuable mulch. Experiments carried out at Embilipitiya do not support the view that alternate husbandry with a three-year pasture break is the solution.

Water, and water alone, would appear to provide the answer. Water is wanted not in the large volumes needed for paddy cultivation but in quantities to maintain a p.F. sufficient for a more luxuriant vegetation than we have hitherto had.

This water has to be stored in the soil both by a water-conserving agronomy and such other methods as periodical basin-listing. These measures on individual farms must be supplemented by reservoirs for each unit-control area in which run-off is stored. These reservoirs will serve not only to meet needs of man and beast, but also to maintain a suitably high water-table. Without water conservation all other measures are at best palliatives which only treat the symptoms.

CONCLUSION

The history of erosion all the world over has been one of soil misuse, wasteful exploitation, attempts to get rich quickly and secure big dividends. The remedy must be found in a system in which soil waste is balanced by the rate of soil formation. It is in forests, undisturbed by man or beast, that one finds the optimum expression of the several factors of climate, specially temperature and rainfall. We do not need to go back to roots and berries. We have to imitate nature where the triple alliance between soil, plant and animal work in a mutual compact for the preservation of all three partners.

If need arose, we may have to make do with smaller profits so long as we do not tax the soil unduly. Even exports may have to be modified so that processing is carried as far as possible. We can thus ensure that as much of the fertilizing elements as possible are retained on the land. It is only then that we can make sure that our soils are so husbanded that wealth accumulates and men will not decay. It is also possible that in the new agriculture both large and small holdings will give way to middle class owners who will be united together by the bonds of co-operation.

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(1) Capsicum annuum Linn.
(2) Gossypium Spp.
(3) Zea Mays Linn.
(4) Eleusine coracana Gaertn.

SOIL EROSION IN CEYLON

WITH PARTICULAR REFERENCE TO FLOODS

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SUMMARY

THIS paper is intended to show that Soil Erosion in Ceylon is intimately connected with the problems of Flood Control, Drainage and Irrigation. An attempt has been made to indicate that very great forces are at work when heavy rains, driven by strong winds, come in contact with cleared land or thinly planted tea estates. The study is carried a step further by pointing out that great damage can be done when these heavy rains run off the hill catchments of Ceylon to join the tributary streams. In the final analysis reference is made to the destructive forces at work in the kinetic energy of swiftly flowing rivers. The general theme is to draw attention to the erosive forces at work by converting them into equivalent horse power which gnaws away at the land everywhere and carries off the top soil to the sea. The residue of heavy bed material blocks river channels, fills detention reservoirs, accumulates in irrigation canals, forms sand bars at river mouths and is one of the greatest obstacles in the solution of problems connected with the work of the Irrigation Department.

Suggestions have been made for the prevention of soil erosion so that future generations will not die of starvation due to our neglect in preserving the source of food production in the Island.

SOIL EROSION IN CEYLON

Practically all our food comes from the soil which is the backbone of civilization. Good soil, water and sunshine in the right proportions are necessary to produce good crops which are so badly needed now to prevent famine and starvation in many lands.

The population of the world is increasing by one per cent. each year, so that in 100 years the present population will be doubled; in 200 years the population will be four times as great as it is now and so on. From mathematical analysis alone the population of the world will be so great in the future that the world will be unable to support it. Whether the present increase in population will be maintained is a debatable point, but the

fact remains that even if there is only a relatively small increase in the present world population, the conservation of soil and water demand attention now in the interests of the present generation and those as yet unborn.

It has been estimated that about twenty-five million tons of soil are washed off the surface of Ceylon each year and carried off to the sea. A large percentage of this material is top soil which is so essential to maintain plant life. It usually happens that the finer particles which make up the best soil are carried away first and the heavier particles follow along later on.

The principal forces at work in this Island, responsible for soil erosion, are those caused by rainfall. We cannot control rainfall at the present time so we must accept whatever comes. Most of the rain which falls on the Island is picked up as water vapour from the surrounding ocean and is carried inland by the off sea breezes which are known as Monsoons. The South-west Monsoon usually blows from April to October, and the North-east Monsoon from November to March. During the South-west Monsoon the west and south coastal areas of Ceylon receive heavy rainfall while the East and North portions get the heavy precipitation during the North-east Monsoon. As a result of these rains practically the whole Island is suffering from erosion, but particularly the hill country where the rains are heaviest.

When the vapour laden clouds which are blown in from the sea reach the hills around the middle of the Island these clouds are forced upwards to cross over the hills. At the higher altitudes the clouds are chilled and rain is precipitated sometimes with very great intensities under high wind velocities. In looking over the publications of the Colombo Observatory, one can get some idea of these intensities and velocities. For instance, in 1907, Colombo had a rainfall of 10 inches in 90 minutes ; in May, 1940, over a large portion of the Kelani Valley about 50 inches of rain fell in five days and almost 20 inches on one of these days ; in 1941, about 21 inches of rain fell in five hours in the Mahaveli Catchment above Gampola. At places in the hills rainfalls of 30 inches or over in twenty-four hours have been recorded. There is a great shortage of reliable data on wind velocities in the hills, but it is safe to assume that these velocities are higher than the velocities in Colombo where gusts of 50 to 60 miles per hour have been recorded.

In looking over the rainfalls in Ceylon that have caused bad floods it is evident that when a storm breaks, as it usually does about the beginning of each monsoon, there are usually a few days of heavy rain before the deluge comes. These few days of heavy rain fill the river channels and the areas subject to floods near the river channels, so that when the real heavy rains come, most of the top soil carried in suspension, goes directly to the sea. During storms lasting from five to fifteen days, the rainfalls at some of the hill stations may vary from 25 to 75 inches. The rainfall in the Hatton District is over 300 inches a year compared with about 30 inches a year in the British Isles.

These very intense rains falling on the ground at very high velocities, caused by the force of gravity and strong winds constitute a tremendous force which erodes the top soil wherever it comes in contact with it. If the ground is fully covered by a blanket of trees, shrubs and grass, the force of the rain drops is partly absorbed by this covering. In addition, the raindrops are held on the ground for a sufficient length of time so that part of the rainfall is absorbed to replenish the ground water supplies.

Few people realize the amount of energy which is expended by rain drops in striking the ground. Assuming a rainfall of 1 inch per hour, travelling with a wind at 10 miles per hour, the energy of the rain drops is expended at the rate of 0·4 horse power on one acre of land. As previously pointed out, rain often falls in Ceylon at the rate of 4 inches per hour which, when travelling at 10 miles per hour, is equivalent to 1·6 horse power hours per acre. If this same amount of rain were to strike the ground at 50 miles per hour, then the rate of doing work would be 40 horse power (approximately) for one hour. For 5 hours at 50 miles per hour the work done is equivalent to 200 horse power hours (approximately) or say, one horse working 8 hours a day for 25 days on one acre. This amount of work, if properly utilized, could plough one acre ten times or more thus indicating the energy at work. Table I shows the energy delivered by the impact of rain drops in horse power per acre for various rates of precipitation striking the ground at certain velocities.

As these rain drops approach the ground, the energy which they contain is dissipated in one way or another. Where there is a cover crop on the land, a good deal of the energy of the rain drops is expended on this cover crop which may consist of trees, shrubs and an undergrowth of grass or weeds. Where all this cover crop has been removed, the energy comes directly into contact with the top soil. Measurements taken on tea estates show that a very high percentage of the soil is fully exposed to rain drops. Tea bushes, for some reason or other, are not planted closely together. In many places, the soil is forked and all the weeds removed so that the top soil is more vulnerable to erosion. We are fortunate to have soils in Ceylon which resist erosion so well in spite of our present methods of cultivation.

Experiments have been carried out to determine the relative rates of run off from cleared and uncleared land on slopes lying near each other. These experiments have shown that water runs off cleared land, where the grass has been removed, much more quickly than where the natural foliage and vegetation exist in an undisturbed state. More experiments are needed to get exact relationships, but the experiments carried out so far, in a preliminary way are quite conclusive in indicating what takes place. The foliage and vegetation, especially the grass, offers considerable resistance to the flows of water on the surface. The briars, old rotton branches of trees and jungle hold back the run off in the same way that they obstruct the passage of pedestrians through the jungle. On cleared land, water runs off as fast as it is poured on, especially in those places where the ground is firm and undisturbed.

The amount of energy in rain drops is very largely absorbed when each drop reaches the ground. However, if the rain is heavy, and the ground has a steep slope, these rain drops run together towards the lowest point finally joining a tributary or river which takes them to the sea. Assuming a rainfall of 4 inches per hour and the velocity of the run off in the gully leaving one acre to be 20 ft. per second (a very common velocity on the steep hills of Ceylon), the energy in this run off is equivalent to 2·86 horse power. On a square mile of area, assuming the same velocity, the energy would be 1,840 horse power. Where the rain falls on the ground the run off velocity is very small. However, as these drops collect and run down the hill sides,

the energy available for erosion purposes becomes large. The greatest erosion usually occurs at the bottom of these hillside gullies just before the run off water joins some tributary stream. There are plenty of estates where the rainfall is more than 4 inches per hour, and the velocity of the water running down the gullies from these estates is greater than 20 ft. per second, in which cases the horse power at work tearing up the estates would be greater than 1,840 horse power per sq. mile. Table II shows the kinetic energy in horse power of discharge per acre of catchment for various rates of precipitation running off a catchment at certain velocities.

In a river moving along quietly to the sea the energy does not make itself manifest and yet the energy is there in relatively large quantities. During floods, the quantity of water is greatly increased and the velocity is also increased so that the energy of a river is considerably increased due to both of these factors, especially the velocity. During the recent floods, when the discharge of the Kelani River at Colombo was estimated at 222,000 cusecs, travelling at 7 ft. per second, the energy in the river was about 19,000 horse power. On the Mahaweli Ganga, in Kandy (Tennekumbura), the peak discharge was 210,000 cusecs travelling at 17·5 ft. per second, which if converted into energy, would give 113,000 horse power approximately. Table III shows the horse power in the kinetic energy of the discharge moving at certain velocities in a river.

The foregoing analysis is intended to show that during heavy rains there are tremendous forces at work. The rain drops dig up the soil upon striking the ground ; the run off water carries away the soil and scours gullies on the hill sides. The rivers carry away part of the material which is deposited in their beds by the tributary streams and in addition erosion of the river banks and adjoining areas takes place as the rivers flow to the sea. It does not seem reasonable that such tremendous forces could be expended, while rain water is passing from the clouds to the sea, without doing a great deal of damage.

The devastation caused by the recent floods furnished conclusive proof that heavy rains do wash away the top soil even if the best known methods have been used to protect it. In many places huge land slips occurred, as at Blackwater Estate on the Ceylon Government Railway, and at other points the roads and railways were blocked by sand and boulders. Some of these boulders were 4 to 5 ft. in diameter. In the river channel near Ulapane, huge pieces of rock about 8,000 cu. ft. capacity were moved along the river bed. There are large deposits of sand on the banks of the Mahaweli Ganga now due to the recent floods, and the river channel below Gampola Bridge is partly blocked by stones from 1 ft. to 4 ft. in diameter. The town of Gampola was practically buried in river borne silt, which in some places was over 2 ft. deep, when the August 1947 floods subsided. Above Alawwa Bridge on the Maha Oya there is a deposit of silt which occupies two-thirds of the ordinary river channel.

Soil erosion is intimately connected with floods and the mapping out of flood protection schemes in Ceylon. At the present time the Irrigation Department has under consideration five large flood protection schemes, viz., the Kelani Ganga, Kalu Ganga, Gin Ganga, Nilwala Ganga and Gal Oya.

In addition, designs are now being worked out for seventeen large reservoirs including Gal Oya and Walawe Ganga Reservoirs which are receiving the attention of Consulting Engineers in America. It is well known now that some of these proposed reservoirs will fill with silt in a few years and become useless as detention reservoirs unless silt is kept out of them.

On the flood protection schemes for the lower reaches of Ceylon rivers, it has been found that the heavy silt charge which comes down from the hills blocks the river channels and the river mouths thus rendering these schemes, which were constructed to increase food production, of little use. In connection with the proposed new flood protection scheme which has just been evolved for Colombo the biggest problem to be faced is the silting up of this new channel and outfall to make the proposed scheme a success. There is every indication now that dredges will be required to maintain the new channel in view of the amount of silt which is coming down the river. The scheme itself will be costly, but the maintenance charges will also be high due to bed load. The problems connected with flooding, drainage and irrigation are difficult and expensive enough in themselves, but the silt question makes these problems much more costly to solve.

In order to remedy the existing set of conditions and prevent further erosion it is evident that drastic steps will be necessary. Many of the planters in Ceylon realize what is happening to their estates and are doing a great deal to prevent further erosion. In other places little attention is given to the subject. Legislation will probably be necessary to educate all concerned in the necessity for soil conservation with which is ultimately connected the problem of water conservation. From an engineering view point the methods to be adopted to prevent soil erosion include very close planting of tea bushes to break the force of the falling rain drops ; the removal of the policy of clean weeding by substituting the cutting of weeds which should be allowed to lie where they are cut ; the continued use of contour ridging and replacement of top soil from the contour drains ; the building of small dams on the hillside gullies to keep the velocity of the water down to a minimum and the adoption of any other methods which will keep the soil on the estates where it belongs.

In May, 1938, when Sir Andrew Caldecott opened the Hydraulic Laboratory in Colombo, he concluded his address with the following quotation :—

> " Little drops of water
> Little grains of sand
> Need a deal of watching
> To protect our land ".

There is a lot of truth as well as poetry in those four simple lines, which sum up the whole story of soil erosion in a very few words.

In conclusion, I would like to thank Mr. S. J. Bocks, Assistant Irrigation Engineer in charge of the River Gaugings Sub-Division at the Hydraulic Research Laboratory, Jawatta road, Colombo, who worked out the figures for the three tables which accompany this paper. My thanks are also due to Mr. S. G. Taylor, Director of Irrigation, Ceylon, for permission to publish this paper.

TABLE I

Table of Energy delivered by the Impact of Raindrops.

$$HP = \frac{hV^2}{262}$$

Where HP is the energy delivered in Horsepower per acre;
h is the intensity of precipitation in inches per hour; and
V is the velocity of the raindrops before impact in miles per hour.

Precipitation in Inches per Hour.

Velocity of raindrops—Miles per Hour.

V	h 1	2	3	4	5	6	7	8	9	10
5	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0
10	0·4	0·8	1·1	1·5	1·9	2·3	2·7	3·0	3·4	3·8
20	1·5	3·1	4·6	6·1	7·6	9·2	10·7	12·2	13·8	15·3
30	3·4	6·9	10·3	13·8	17·2	20·7	24·1	27·5	31·0	34·4
40	6·1	12·2	18·3	24·4	30·5	36·6	42·7	48·8	55·0	61·0
50	9·6	19·1	28·6	38·2	47·7	57·3	66·9	76·4	85·9	95·5
60	13·8	27·6	41·4	55·2	69·0	82·8	96·6	110·4	124·2	138·0

Horse Power per Acre,
Table I

TABLE II

Table of Kinetic Energy of Discharge per acre of catchment when run-off equals Intensity of Precipitation.

$$HP = \frac{hV^2}{563}$$

Where HP = Kinetic energy of discharge in horse power per acre of catchment;
h = Intensity of precipitation in inches per hour;
V = Velocity of flow in ft. per second.

Precipitation in Inches per Hour.

Velocity in feet per Second.

V	h 1	2	3	4	5	6	7	8	9	10
5	—	0·1	0·1	0·2	0·2	0·3	0·3	0·4	0·4	0·4
10	0·2	0·4	0·5	0·7	0·9	1·1	1·2	1·4	1·6	1·8
15	0·4	0·8	1·2	1·6	2·0	2·4	2·8	3·2	3·6	4·0
20	0·7	1·4	2·1	2·8	3·5	4·3	5·0	5·7	6·4	7·1
25	1·1	2·2	3·3	4·4	5·5	6·7	7·8	8·8	10·1	11·1

Horse Power per Acre,
Table II

TABLE III

Table of Kinetic Energy of River Discharge.

$$HP = \frac{QV^2}{568}$$

Where HP = Horse power in kinetic energy of Discharge;
Q = Discharge in cusecs; and
V = Velocity of flow in ft. per second.

Velocity of Discharge in ft. per Second.

Q	V 5	10	15	20	25
50	2	9	20	35	55
100	4	18	40	70	110
500	22	88	198	353	551
1,000	44	176	397	705	1,102
5,000	220	881	1,983	3,526	5,508
10,000	441	1,763	3,967	7,053	11,017
50,000	2,205	8,815	19,835	35,265	55,085
100,000	4,410	17,630	39,670	70,530	110,170
200,000	8,820	35,260	79,340	141,060	220,340
300,000	13,220	52,900	119,000	211,600	350,500

Horse Power of Discharge,
Table III

FORESTS AND EROSION—WITH SPECIAL REFERENCE TO CEYLON

R. A. de ROSAYRO,
ASSISTANT CONSERVATOR OF FORESTS

ABSTRACT

CONSERVATION of the soil and the conservation of forests are closely related. The history of denudation of forests in tropical and sub-tropical countries is allied to its agricultural history, whether it be the continuation of the primitive practice of shifting cultivation or the introduction of new and permanent forms of agriculture.

Forests exert a direct and important influence on water-supply and stream flow and especially on the control of erosion. The results of scientific investigations conducted by the direct or hydrometric method and the indirect or analytical method demonstrate that forests reduce run-off, regulate stream-flow and provide the most effective cover for the prevention of erosion. The fertility of the soil, as reflected in its physical properties of permeability and air capacity, is higher in forest soils than in comparable arable or grassland soils.

Erosion in Ceylon, with its attendant features of severe floods and landslips, is primarily due to the denudation of forests in the steep montane region and their replacement by permanent agricultural crops. The damage caused by shifting cultivation is less permanent and not specially marked in the montane zone, where the effects of soil erosion are most serious. The firing of grasslands results in soil-deterioration, but seldom in extensive erosion.

Soil conservation measures based on forest practice aim primarily at controlling erosion at its source. Legislation against deforestation and for the maintenance of protection forests requires revision and the organization necessary to implement it. The demarcation and reclamation of the catchments of the principal rivers subject to floods, the protection of stream and river "reservations" and the fixation of unstable hillsides prone to landslips are measures based on forestry which are suggested as immediate and practical steps to control erosion. The regulation of grassland burning and the control of shifting cultivation are also suggested.

INTRODUCTION

Conservation of the soil is intimately bound with the conservation of forests. This fact is often ignored or overlooked in the economic development of a country where forests have to be cleared to make way for agricultural crops. In most tropical and sub-tropical countries, the historical background

for the present condition of the country in relation to its agricultural development provides interesting study. In several tropical regions, the increasing poverty of the land and soil is largely due to the unchecked exploitation of forests. In Ceylon, the historical background is somewhat different from that of other tropical regions, especially India and Africa. Ceylon, with its relatively unexplored resources of forest land, offered scope for the investment of capital in coffee and later in tea and rubber. In Africa and India an important reason for the destruction of the forests was the continuation of the native custom of deforestation either for shifting cultivation or the extension of grazing grounds.

In temperate climates the gradual disappearance of forest and its replacement by agricultural crops did not prove detrimental to the people so long as timber and forest products were readily and cheaply imported. The importance of forests in soil conservation in most temperate countries of the old world is certainly not so obvious. With the moderate and evenly distributed rainfall in temperate climates, systems of agriculture have been evolved in the course of centuries in keeping with the climate and have not seriously disturbed the balance of nature. In tropical and sub-tropical countries the destruction of forests, on the other hand, has been attended with serious and far-reaching consequences.

THE INFLUENCE OF FORESTS

The effects of forests on the conservation of moisture, the regulation of stream-flow and the conservation of the soil are generally known but seldom given the full importance they deserve. Experimental data are not readily available from tropical countries. The experimental work done in temperate countries gives us, however, an insight into the whole question. Scientific proof of the effect of forests on water supply and stream-flow has been obtained by, (*a*) the direct or hydrometric method and (*b*) the indirect or analytical method. The best known examples of the former are the investigations of Engler (1) in the Emmental, Switzerland, and Bates and Henry (2) in Colorado. This method has, however, not proved wholly satisfactory. "Within their limitations, however, the investigations so far carried out tend to show that forests reduce run-off and regulate stream flow, causing a stronger flow in dry weather, and the water discharged from forest tracts contains less sediment than that discharged from bare tracts" (3). The chief results of the indirect or analytical method may be summarized (3) as follows :—

"(i) the total loss of water by interception, evaporation and transpiration is more or less similar for forests and field crops, though much depends on the kind of forest and crop ; it is somewhat in excess of the loss by evaporation from bare ground in the open ;

(ii) In mountainous country, run-off is the factor most affected by the presence or absence of vegetative cover, and by the nature of the cover ; closed forest—particularly with litter-covered ground—is on the whole the most effective cover for the prevention of run-off, though other closed

vegetation such as Bermuda grass pasture or *Lespedeza*, is also very useful; both are much more effective than ploughed land, open crops like cotton, or abandoned fallow land;

(iii.) removal of forest litter or low vegetation by burning greatly increases run-off; this points to the economic superiority of protected forest over pasture land for catchment areas, since forest can be regularly worked, whereas pasture land would be subject to drastic grazing restrictions and would thus lose much of its economic value;

(iv) forest litter has a filtering effect, which prevents the clogging-up of the surface soil that takes place with the impact of rain on bare ground".

Among the several investigations carried out on these lines, a few may be cited as of interest in relation to the conditions in this country:—

(*a*) Observations by Duthie, Hardy and Rodriguez (4) in tropical rain forest in Trinidad showed that the evaporation of water in the open was 3-5 times that in the forest. The actual rainfall for the year of observation was 111 inches.

(*b*) Experiments carried out by Lowdermilk (5) in China demonstrate that with ordinary rainfall the ratio of run-off in the forest to the open increases, *i.e.*, there is a limit to the degree of absorption of water by forest soils. Even with heavy rainfall there is, however, an appreciable difference.

(*c*) Gorrie (6) in the Punjab showed that the degree of run-off was approximately 16 times more for overgrazed and virtually bare land than for eroding land reclaimed by afforestation and construction of bunds.

(*d*) Hornby (7) in Nyasaland found that the destruction of tree-growth in native cultivation had increased run-off from 33 per cent. of the rainfall in forested areas to 69 per cent. in cleared lands.

The physical properties of the soil which most affect plant growth are permeability and air-capacity. Burger's (8) investigations showed that the increasing fertility of Swiss forest soils depends on an increase in their air-capacity and permeability and that both air-capacity and permeability are considerably higher in forest soils than in comparable arable or grassland soils, although the total porosity (air and water capacity) need not be necessarily higher. According to Burger's results, clear cutting lowers the air-capacity of the soil by some 40 per cent. and frequently reduces permeability to a fraction of its previous figure. Even after a period of 10 years, soil left bare after clear-cutting had a permeability roughly 30 times less than a good forest soil. Even where artificial regeneration is established without delay, many decades pass before the soil regains its original structure. The results of clear-cutting

on the structural properties of the different soils are not uniform. The effect varies with the climate and the site conditions. Generally speaking, however, the structural properties of clayey soils are more affected by clear-cutting than sandy soils. The deterioration of the physical properties of the soil may be lessened to a considerable extent if the understorey is left intact or introduced before clear-cutting takes place (9).

SOIL EROSION IN CEYLON

The chief cause of erosion in Ceylon is the denudation of forests; secondly, and only limited in its incidence, is the effect of firing of grasslands (*patanas* and *talawas*). Shifting cultivation in the tropics has been held resposible for the destruction of large tracts of forest, the impoverishment of the soil and the replacement of a tree cover by worthless scrub or grassland. Although shifting cultivation is generally held to be the chief cause of soil erosion in the tropics, as practised in Ceylon it is confined to large tracts in the Dry Zone where, from the comparatively flat nature of the land and poor rainfall, soil erosion never assumes serious proportions. *Chena* cultivation in the montane zone is very limited in its extent. The severity of erosion is to some extent mitigated by the fact that within a few years, the clearings are abandoned and if left undisturbed revert to some form of vegetative cover, even if only scrub. Fire and grazing are the chief causes of the permanent deterioration of the soil and increasing liability to erosion. In Ceylon, however, overgrazing is seldom in evidence and burning is confined to grasslands and savannah forest.

The serious nature of the problem of soil erosion in Ceylon has been recognized for some years. This is especially true of the hilly country of the central and south-west portion of the Island where a large proportion of the pristine forests have been converted into extensive plantations of tea and rubber within a short period of under a century. The initial clearing of these forests in a region of high rainfall with steep slopes predisposing to heavy run-off and erosion, combined with systems of agriculture which not only excluded any form of soil cover but also encouraged the loosening of the surface soil, resulted in serious erosion, the silting of rivers and their increasing liability to floods. Even as early as 1894, the Kelani Ganga in its upper reaches which were navigable at that time were observed to be silting up rapidly; the cause of the silting was held by competent authorities to be the increasing cultivation of tea (10).

The majority of rubber estates, since the early "Twenties" have adopted the maintenance of a ground-cover as general practice, but in tea estates the immediate practical disadvantage of a ground-cover and the traditional importance attached to clean-weeding were more weighty considerations, so that it is only recently that there has been progress towards the establishment of a soft ground-cover.

Although a ground cover is regarded as the most satisfactory individual method of preventing erosion in that it anchors the soil and increases its absorptive capacity, the importance of other soil conservation measures have not been overlooked. From the earliest times large estates have adopted a system of drains but these were usually laid out at relatively steep

gradients. There has been a gradual tendency to convert these into drains on the contour or at a slight slope, but this practice has not yet become universal. More advance has been made in rubber areas where a very effective system of a combination of ground-covers with stone terraces, contour platforms, contour trenches and silt-pits has been reached. In the more remote and inaccessible estates, especially in small holdings, soil conservation measures are still very inadequate.

The cumulative effects of erosion in tea estates, especially in certain districts of the Central Province which contain the main catchments of two principal rivers of the Island, the Mahaweli and Kelani Gangas, have admittedly contributed to recurrent flooding in the lower reaches of these rivers. During the recent floods (August, 1947), landslips were mainly responsible for the great loss of lives, disorganization of communications and loss of property. It is no mere coincidence that the major landslips occurred in regions where tea has almost entirely replaced forest or *patana*. On the steep foot-hills of the Pedro and Adam's Peak ranges, where damage by landslips has been most severe, an interesting phenomenon may be observed where large masses of tea-land have fallen but the forest immediately above has remained intact.

Within recent years, encouraged by the food-drive, small extents of both forest and patana in the montane zone have been brought under temporary cultivation. Although the actual total extent involved is insignificant in comparison with the extent under permanent cultivation, the practice has caused the indiscriminate clearing of protection forest on steep slopes or in stream reservations and will, if unchecked, result in serious erosion. The continuous and repeated firing of the grasslands, especially the extensive montane grasslands or *patanas*, though seldom producing extensive erosion, results in general soil deterioration and incipient erosion.

FORESTRY AND SOIL CONSERVATION

Soil conservation measures based on forest practice aim primarily at controlling erosion at its source. Where erosion is largely due to the devastation of forests, the obvious remedy lies firstly, in prohibiting or controlling deforestation by legislation, and secondly in the reclamation of catchment areas which are now devoid of forest cover.

Under the Forest Ordinance of 1907 various categories of forest are declared reserved forests. Reserved forests in the hill country, from their position on steep slopes and in catchment areas, fulfil a function as protection forests. The earliest regulation of Government was an order prohibiting the alienation of land over 5,000 feet elevation. This was subsequently relaxed in respect of *patana* land. There is, in addition, a General Order prohibiting the alienation of land at any elevation which is required for protecting the sides of ridges and the sources and banks of streams. A more recent order (1940) precludes from cultivation, land with a slope of over 30 degrees and the tops or whole of forest clad hills (11). It is hoped that any Soil Conservation Ordinance contemplated will include more comprehensive legislation for the protection and demarcation of catchment areas, stream and river "reservations" and for the effective protection of climatic or protection

forests. The immediate necessity for the demarcation of unprotected catchment areas of the principal rivers subject to floods, which find their sources in the montane region, should be recognized in any comprehensive scheme of soil conservation for the country. The demarcation of catchment areas can only be done by careful survey and planning. Aerial survey, which is now a recognized means of land-planning, will be the best method of collecting the required data expeditiously and thoroughly. Aerial survey has already been employed for assessing the extent of the damage during the recent floods and for the basis of the new flood-control schemes.

The reclamation of heavily eroded catchment areas, especially in tea estates, can, perhaps, be obtained most quickly and effectively by methods based on natural regeneration. This is very simply achieved by allowing the crop cultivated to grow wild. The natural colonization of grass, herbaceous, and subsequently shrub and tree species, will inevitably follow. The results obtained in the Roehampton Estate catchment area for Diyatalawa show that this method can be adopted with success. The tea there grows rapidly forming a dense understorey with invasion of indigenous shrubs and weeds, while the shade trees of *Grevillea* and dadap form a good over-storey protection with good leaf-litter for restoring soil fertility. In the more severely eroded areas it may be necessary to introduce rapid soil-covering species. For this purpose in the wet montane zone with a rainfall of 100 inches and over, a suitable species would be *Acacia decurrens* which regenerates prolifically from seed, forming a thicket. Simultaneously with the reclamation of catchment areas the protection, and if necessary, the afforestation of unprotected river and stream "reservations" should be taken up.

There is no doubt that a progressive change will have to be adopted in the agricultural practice in the hill country where more comprehensive and efficient soil conservation measures are necessary. These do not properly fall within the scope of forestry and are therefore not dealt with in this paper. In passing, however, the need for the general adoption of a suitable soil cover is worth stressing, in conjunction with simple mechanical methods such as brushwood contour barriers or terraces. Afforestation along with some form of mechanical revetment is also necessary in the fixation of unstable and denuded hillsides where landslips are of frequent occurrence.

The introduction of rotational grazing and controlled burning are necessary to prevent the current, highly destructive practice of indiscriminate patana burning and grazing. Legislation alone cannot achieve this end without educational advancement and effective propaganda. Finally, the control of shifting-cultivation will probably be the most difficult to achieve. The change from this time-immemorial and primitive form of cultivation to systems of permanent agriculture can only be brought about gradually. The more rigid enforcement of the existing legislation regulating the alienation of steep land for cultivation will be the most effective means of controlling shifting cultivation in the montane zone. The introduction of co-operative reafforestation in the Dry Zone has successfully provided a rapid means of re-establishment of a forest cover. This scheme deserves more encouragement and recognition as suitable form of land utilization for the degraded forest types of the Dry Zone.

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64. Whitby—Disorders of the Blood.
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5. Boletin De Industria Animal.
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8. The British Mycological Society Transactions.
9. British Rubber Development Board Pamphlets.
10. Cage Birds and Bird Fancy.
11. Ceylon Health News.
12. The Ceylon Trade Journal.
13. Chemical and Engineering News.
14. Council for Scientific and Industrial Research, Australia, Annual Reports.
15. The Crown Agents Review.
16. The Dairy Farmer.
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18. Dominion of New Zealand Museum Records—Entomology.
19. Dominion of New Zealand Museum Records—Ethnology
20. Dominion of New Zealand Museum Records—Zoology.
21. Economic Botany.
22. Estacion Experimental Agronomica, Cuba
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24. Fertilizer and Feeding Stuffs Journal.
25. Fiji Agricultural Journal.
26. The Gardener's Bulletin, Singapore.
27. Harper Adams Utility Poultry—Bulletins.
28. Harper Adams Utility Poultry—Leaflets.
29. Harward University Botanical Museum Leaflets.
30. Il Tabacco.
31. India Rubber Journal.
32. Institute Coloniale De Marseille Publications.
33. Institute Royale Coloniale Belge Publications.
34. The Irish Bee-keeper.

35. Jamaica Department of Agriculture—Extension Circulars.
36. Journal of Animal Science.
37. L'Erabliere Laurentienne Contributions.
38. Ministry of Agriculture and Fisheries, Scotland—Publications.
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THE RUBBER RESEARCH INSTITUTE OF (MALAYA)

BUDGRAFTING WITHOUT WAXED BUDDING TAPE

BEFORE the war we recommended that in budgrafting the bud patch should be bound to the tree with a bandage made of cotton cloth soaked in wax.

This method cannot now be used for cotton cloth is scarce and expensive and suitable wax almost unobtainable. Changes in budding technique have, therefore, become necessary and a method of grafting is now recommended using coconut fronds and hessian string in place of the waxed bandages.

Except for the modifications described below, the method of budding with these new materials is the same as the standard method using waxed cloth.

The flap should be opened from the bottom upwards and the bud patch inserted in the manner shown (Fig. 1).

Cut the fresh green leaflets of a coconut palm frond into four-inch lengths. Place one of these lengths over the flap with the upper side towards the stock and press in the flap firmly against the stock.

The flap, budpatch and coconut leaf are then bound tightly to the stock with a piece of hessian string from 3 to 4 feet long, depending on the size of the stock. The first turn of the string is made round the bottom end of the flap and coconut leaf (Fig. 2) after which, it is wound round the stock five or six times, rising in a spiral so that the last turn of the string is round the top of the leaf. The end of the string should be slipped under the last turn and pulled firmly to hold it in place (Fig. 3).

In dry weather this method is nearly as good as using waxed bandages. It is, however, less efficient in keeping out the rain and in wet weather up to ten per cent. fewer successes may be expected.

The string costs about cents 60 per lb. of 1,200 feet or $2 per 1,000 buddings.

July 31, 1947.

FIG. 1.

From Original Supplied by D. A.

Printed by Survey Dept., Ceylon. April 1948

FIG. 2.

FIG. 3.

THE RUBBER RESEARCH INSTITUTE OF (MALAYA)

NOTES ON HEDGE PLANTING OF RUBBER

HEDGE planting is a very exaggerated form of avenue planting in which the trees may be as close as 3 feet in the rows and the distance between the rows as much as 75 feet. Forms of hedge planting have been used largely in East Java when mixed planting is practised and rubber trees serve as shade trees for coffee, tea or other crops planted between the hedges. This special form of planting of rubber received a stimulus during the period of rubber regulation owing to the ruling by the N. E. I. authorities that for the purpose of estimating the acreage planted with rubber isolated hedges should be deemed to be 7 metres wide. This ruling made it possible for example, to plant about 210 trees per acre at intervals of 3 feet in hedges about 70 feet apart in areas already planted with coffee or some other crop. For the purpose of rubber regulation only one third of each acre so planted would be regarded as being planted with rubber. As a means of making the best use of new planting rights hedge planting was an attractive system.

Except for a few small experimental areas the system has not, to our knowledge, been used in Malaya and we are dependent for information on reports from the N. E. I. and in particular on two papers by Schweizer published in de Bergcultures in 1939 and 1940.

2.—ADVANTAGES OF HEDGE PLANTING

Schweizer made the following claims for this system of planting :—

(i) Interplanting of rubber with other crops, either temporarily or permanently, is possible without damage to the rubber.

(ii) Yield and growth of the rubber trees are satisfactory, although the latter differs from growth under normal conditions.

(iii) A high stand per acre can be maintained.

(iv) An increase in the foliage assimilating area of the rubber trees makes possible a higher yield per acre at high stands.

(v) Thinning out can be carried out over a longer period and is more accurate with Hedge-planting than with Square-planting.

(vi) Rotation of crops is possible.

(vii) More light and air reach the stems of the trees and they are therefore less liable to panel diseases.

(viii) Replanting when the old rubber is worn out or obsolete is easier.

3.—DISCUSSION OF ADVANTAGES CLAIMED FOR HEDGE PLANTING

(i) *Interplanting.* The desirability of interplanting with other crops is an economic question and need not be discussed here. That interplanting can be done between hedges is self evident. The period during which the interplanted crop is to be retained must have a big effect in determining the optimum distance between the hedges.

(ii) *Yield and Growth.* The first comparison that Schweizer makes is between a hedge on Djember and a field of young rubber planted 18′ × 18′ at the same time on Renting Estate. At the age of four years and ten months the growth measurements were :—

	Hedge Planting (Djember Expt. Station).	Square Planting (Renting Estate).
Girth (cm)	43	46
Bark thickness (mm)	5·3	5·9
Height (m)	16	13

Observations taken two years later showed that the thickness of the virgin and renewed bark was still satisfactory.

In the fifth year the Djember hedge was brought into tapping and yielded 2·4 lb. per tree per annum in the first year and 5 lb. in the second. Since the distance between the hedges was 32 ft. this is equivalent to a yield of 2,000 lb. per acre. The yields of the individual trees ranged from 2 lb. to 4·9 lb. per tree in the first tapping year.

A newly planted hedge on Kaliwining confirmed that up to the fifth year the girth is greater and the bark thicker in square planting at normal distances than in hedge planting.

The early growth of trees planted in a hedge differs from normal planting. The trees are much taller and there is a reduction in their girth and bark thickness. There is also a tendency for the stems at first to be elliptical in cross-section with thin bark on the flattened sides along the axis of the hedge. This is a direct consequence of the fan-shaped development of the crowns which results from the unequal planting distances.

On the other hand a fourteen-year-old hedge at Kaliwinning had stems circular in cross-section and with an even thickness of bark. This shows that the abnormal shape of the stem in young hedges is of a temporary nature only.

The following measurements were taken on the trees in the Kaliwining hedge which was planted with buddings of 25 unproved clones.

Age of trees	14 Years
Mean girth	26·5 inches
Virgin bark	9 mm
Renewed bark 2 years	5·9 mm
Renewed bark 5 years	8·6 mm (96% of virgin bark)

In the tenth to fourteenth years the yields in gm. per tree per tapping were :—

1934	1935	1936	1937	1938 (9 months)
6·2	8·4	11·9	15·8	22·4

The clones were unproved and the yields as would be expected were low but the figures are valuable in that the yields show an excellent rate of increase every year.

Hedge planting affects the development of the roots as well as the crown. Schweizer found that by the fifteenth year, the lateral roots spread as far as 60 ft. from the hedge, whereas those of a solitary tree only spread to about two thirds of the distance.

The conclusions to be drawn from Schweizer's observations are that hedge planting may give a higher yield per acre owing to the increased number of trees but a lower yield per tree owing to their slower growth and smaller size.

(iii) *Stand Per Acre.* Experiments have shown that during the early tapping years yield per acre increases with stand per acre up to a certain point. The most reliable experiments have been carried out with budded trees and these indicate increases in yield with density up to about 250 trees per acre. (The figures for seedlings may be slightly different but such differences are not likely to be great). Increases above the density of 250 trees per acre under the same conditions appear to give no appreciable increases in yield per acre.

In practice, the optimum stand per acre, or at least the optimum number of trees tapped per acre, will depend partly on the relationship between tapping costs and the sale price of rubber. In general when tapping costs are high in relation to the sale price a high yield per tapper may be of more importance than maximum yield per acre.

It is however generally agreed that thinning out has been too heavy in the past and in most young plantings it is becoming the custom to retain not less than 150 trees per acre for the first few years of tapping. One of the effects of a high stand per acre in normal planting systems which aim at giving an even distribution of the trees is that with early closure of the leaf canopy early death and shedding of lateral branches may take place. Trees become tall poles with a small leaf surface at the top although the extent to which lower foliage is lost depends a little on the Clone. However, the total assimilating surface in dense stands is much reduced and it is contended that such ill effects may be minimized in hedge planting without reduction in total stand per acre.

(iv) *The effect of Hedge Planting on the Assimilating Area.* If the trees are planted in hedges the lateral branches may be retained indefinitely or until the branches of adjacent hedges meet depending on the distance between the hedges. This will result in the retention of a larger assimilating area than would be the case with square planting with an equal stand of trees per acre.

Schweizer deduces from this very plausibly, though there are as yet no figures to support this contention, that the yields of hedges may continue to increase for a longer period than those of a square planting or alternatively that the yields will be maintained longer before they begin to decline. Since latex is derived from the products of assimilation by the foliage this is what would be expected.

(v) *Thinning-Out.* Owing to the big variation in yield of different trees, particularly seedling trees, provision must always be made for extensive thinning out of the poorest grown and poorest yielding trees if the best results are to be obtained.

It has been shown that there is a high correlation between the early and later yields of the individual tree in a clearing, but that the correlation declines slowly with time. The wide spacing between the hedges delays the time when competition becomes so acute that thinning out is necessary and a more accurate selection of the highest yielders can be made. Schweizer contends that up to the age of 14 years, trees of Hevea are "plastic"; that is to say, they will respond to increased spacing by growing more lateral branches and increasing in girth. So long as thinning out takes place before the trees lose their plasticity, the longer it can be postponed the more accurate will be the selection of the poorest trees.

Thinning out will leave an undulating foliage surface to the hedge with a consequent increase in the aassimilating area.

There is also a suggestion that the variation in yield per tree is exaggerated in hedges which would render thinning out more beneficial in hedges than in square plantings.

In the Kaliwining hedge the yields of the 25 clones remained in much the same order in the fourteenth year as they were in the first year of tapping. If this continues, hedge planting might proove a suitable system of conducting clone trials. There must always, however, be some doubt whether the clones that do best at the more usual planting distances will do best in hedges and *vice versa.*

(vi) *Rotation of Crops is Possible.* If for economic reasons mixed planting should be desirable, rubber can be alternated with other crops. If a crop immune from root disease can be selected this would be a cheap and efficient way of ridding land of timber infected by root disease.

(vii) *Advantages of ventilation and exposure.* More light and air would reach the stems of trees planted in hedges than on the square. The tapping panels would dry more quickly after rain and this should reduce the incidence of panel diseases and permit earlier tapping.

(viii) *Replanting.* It is now generally accepted that the economic life of a rubber tree is limited and will probably not exceed twenty or thirty years. Even though the trees are not worn out within that period, the improvements in quality from selection or breeding may render them obsolete. If a regular programme of replanting is undertaken, from one fifth to one quarter of an estate may be permanently out of tapping. Hedge planting may offer a means of reducing or even abolishing the large drop in production that must occur from replanting at normal planting distances. If the hedges are sufficiently far apart it should be possible to interplant between the hedges and to bring the new trees to maturity before cutting out the old ones. A certain amount of root and branch pruning would be necessary but this would be a small item of expenditure compared with the total loss of crop for 5 or 6 years.

4.—OTHER PRACTICAL CONSIDERATIONS

Schweizer's observations on the early growth of hedge-planted trees are of interest;

(i) Early branching gives the maximum leaf area and leads to the maximum growth in thickness of the stems.

(ii) The lamp-brush type of tree grows more quickly if topped. (We found this in experiments with buddings of Clone BD 5, provided the topping was done early enough for the topped tree to overcom · the check in growth by early branching. Topping should take place when the young trees are about 8 feet high to get the best results).

(iii) Pruning or thinning out young crowns checks the rate of girthing by reducing the size of the assimilating area.

(iv) The growth of topped seedlings is more cylindrical (*i.e.*, less conical). Free branching of the crown is associated with a more cylindrical stem.

(v) Topping causes a stronger girthing just below the crown and reduces the risk of wind damage.

(vi) Long stumps (at least 5 ft. in height) are very suitable for hedges, for they grow erect and do not lean away from the axis of the hedge.

It may be concluded from the above that clones or seedling families with an early branching habit are best suited for hedges.

5.—DISTANCES BETWEEN HEDGES

No conclusions can be drawn owing to lack of evidence but it can be assumed however that for clones with an erect branching habit a distance between the hedges of 82 ft. (25 metres) is too great unless interplanting with another crop is undertaken. On the other hand 41 ft. (12½ metres) is probably too close.

Since hedge planting is still in the experimental stage planters would be best advised to try a distance of 50 ft., 60 ft. or 70 ft. between the rows, or all these distances in different fields if practicable.

Schweizer suggests, as an alternative, approximate planting distances of 3 ft. × 30 ft., 3 ft. × 27 ft. or 3 ft. × 24 ft. with the intention of thinning out alternate rows at about 10 to 15 years of age, *i.e.*, after 6 to 8 years of tapping. A very high yield per acre could be ensured

during the first few years and alternate hedges could be cut out when the crowns meet. This seems to be rather optimistic in view of an earlier statement that the branches in the Kaliwining hedge spread to 8 metres on each side by the 14th year. This would also exclude one of the great advantages of hedge planting on steep land which is the big reduction in the amount of terracing necessary. Terraces are usually at 22 ft. apart, but with hedges the number of terraces could easily be reduced to one third.

6.—DIRECTION OF THE HEDGES

On hilly lands the hedges will have to follow the contours if extensive soil wash is to be avoided. On flat land where the hedge can be planted in any direction the question arises whether it would be better to plant North to South or East to West. Rubber trees are sensitive to light and in Java where the sun is in the north for two thirds of the year the fences develop more on the north side than on the south. In Malaya, the position is reversed and greater development would be expected on the south side. On the other hand most assimilation takes place in the morning. Consequently, if the trees were planted North to South to avoid the uneven growth caused by the sun being for most of the year in the south, the East side of the fence would grow more rapidly than the West side. Schweizer considers, that on balance it would cause less uneven growth if the hedges run East to West.

REPORT OF THE PROCEEDINGS OF THE THIRTEENTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD AT PERADENIYA IN THE ASSEMBLY HALL OF THE SCHOOL OF AGRICULTURE ON MONDAY, JUNE 30, 1947

Mr. L. J. Seneviratne, C.C.S., Acting Director of Agriculture, presided and the following were present :—Mr. Malcolm Park, Deputy Director of Agriculture ; Dr. A. W. R. Joachim, Chemist, Department of Agriculture ; Mr. T. M. Z. Mahamooth, Deputy Director, Animal Husbandry ; Mr. C. N. E. J. de Mel, Principal, School of Agriculture, Peradeniya ; Dr. M. F. Chandraratne, Botanist ; Dr. R. V. Norris, Director, Tea Research Institute ; Gate Mudaliyar S. Muttutamby ; Mr. S. Sivapalan ; Mr. S. L. Bandara Dharmakirti ; A. E. Madawala Dissawa ; Sir James P. Obeyesekere ; T. B. Poholiyadda Dissawa ; Mudaliyar N. M. Abulcassim Marakar ; Mr. R. H. Bassett, Marketing Commissioner ; Mr. L. B. de Mel ; Mr. Chas A. M. de Silva ; Col. T. Y. Wright ; Mr. R. H. Spencer-Schrader ; Mr. C. B. Edwards ; Sir Wilfred de Soysa ; Mr. W. A. Guthrie, Assistant Director of Irrigation ; Dr. W. R. C. Paul, Divisional Agricultural Officer, S.-W. D. ; Mr. Marcus S. Rockwood ; Mr. K. Kanagasabai ; Mr. A. R. T. Gibbon ; Gate Mudaliyar N. Wickremaratne ; Mr. R. H. de Mel ; Rev. Fr. L. W. Wickremasinghe ; Mr. R. T. Chelliah ; and Mr. M. J. Perera, C. C. S., Secretary.

Hon. Mr. D. S. Senanayake, Minister for Agriculture and Lands, was present by special invitation.

The following visitors were also present :—Mr. P. G. Malkani, Principal, Ceylon Veterinary College ; Mr. W. A. R. Robertson, Acting Chief Construction Engineer, Irrigation Department ; Dr. B. A. Baptist, Entomologist ; Mr. L. S. Bertus, Acting Plant Pathologist ; Mr. A. V. Richards, Horticultural Officer ; Mr. H. A. Peiris, Divisional Agricultural Officer, S.-E. D. ; Mr. C. R. Karunaratne, Divisional Agricultural Officer, C. D. ; Mr. A. B. Attygalla, Acting Tobacco Officer ; Mr. G. V. Wickremasekera, Research Officer, Kurunegala ; Mr. W. Matthewson, Agricultural Engineer ; Mr. E. J. Livera, Acting Soil Conservation Officer ; Dr. D. E. V. Koch, Assistant Chemist ; Mr. A. L. Johnpulle, Additional Agricultural Officer, C. D. ; Mr. L. J. Arnott ; Messrs. Gratian de Silva and Andrew W. Kannangara, Assistant Agricultural Officers, Propaganda.

Letters and telegrams regretting inability to attend the meeting were received from—Mudaliyar Chinnatamby ; Mr. P. B. Bandaranayake ; Director, Rubber Research Scheme ; Conservator of Forests ; Registrar of Co-operative Societies ; Mr. U. B. Unamboowe ; Mr. Bertram de Zylva ; Mr. J. P. Fernando ; Hon. Mr. Geo. E. de Silva ; Mr. S. Salmon ; Mr. A. G. Divitotawela ; Mr. H. W. Amarasuriya ; Dr. Reginald Child, Director, Coconut Research Scheme.

I. CONFIRMATION OF THE MINUTES OF THE LAST MEETING.

The minutes of the last meeting held on February 24, 1947, copies of which had been circulated among the members, were confirmed subject to some amendments sent in by members.

II. VOTE OF CONDOLENCE.

Sir Wilfred de Soysa moving a vote of condolence on the death of Mr. Walter Molegoda, the retired Propaganda Officer of the Department of Agriculture, said that Mr. Molegoda was one of the officers who had done his duty always in the very best interests of the people of this Country and was very interested and enthusiastic in his work. He had helped the peasant population of this country at large and as such he was one of the officers who deserved the praise of everybody assembled there. Mr. Molegoda was educated at Trinity College and shone

not only in his education but also in other activities of the College. He had started the Katugastota Sports Club and was the Secretary of that Club. He was appointed an Agricultural Instructor in the Department in March, 1909, and had later become Senior Agricultural Instructor. He acted as Senior Agricultural Officer and was subsequently appointed the Propaganda Officer of the Department of Agriculture. In recognition of his meritorious services, he was made a J.P., in 1942, by Government and the Imperial Honour, M. B. E., was conferred in 1946. Sir Wilfred concluded, " He was one, who we could ill afford to lose."

Sir Wilfred de Soysa then moved the following resolution, seconded by Col. T. Y. Wright and supported by Mr. Malcolm Park, Deputy Director of Agriculture, and Gate Mudaliyar N. Wickremaratne :—

" The Board of Agriculture by resolution, expresses its deep sympathy with Mrs. Molegoda and family on the death of the late Mr. Walter Molegoda, J.P., M.B.E., and places on record its appreciation of the services rendered by the late Mr. Molegoda to the Island, in stimulating an interest in Agriculture amongst the peasantry and by his sustained effort on behalf of village Agriculture, thereby contributing in a large measure towards the progress and advancement of the village population.

The Board further resolves to forward a copy of this resolution to Mrs. Molegoda and family. "

The resolution was adopted unanimously by the Board.

Mr. Malcolm Park, Deputy Director of Agriculture, in supporting the resolution paid a tribute to late Mr. Molegoda. He had known Mr. Molegoda for about 25 years and had great love and respect for Mr. Molegoda's unfailing courtesy and his willing co-operation. He concluded that Mr. Molegoda's loss was felt very deeply by everybody and supported the motion.

Gate Mudaliyar Wickremaratne said that he had known Mr. Molegoda as a colleague who had worked with him for a number of years. He added that Mr. Molegoda's success in life was not so much due to his education alone but due to his intimate knowledge of the activities of the peasant class of people in this Country. Sir Henry Blake, then Governor, had organized the Agricultural Society in 1904 and in 1906 he was employing Instructors. During that time employment was not given to " men from big colleges as they do now," but to men who had a good knowledge of the conditions prevailing in the country and who could work with the people. Mr. Molegoda could have become an R.M., or could have even got into a higher post because he had much influence in the higher circles of the Government Service, but yet he preferred the post of Instructor, and he was really proud of his work. Mr. Molegoda's uncle was Dunuwilla Dissawa who was a good friend of the Governor at the time. When the Minister of Agriculture wanted an officer for propaganda work, he could not have made a better selection than Mr. Molegoda. Gate Mudaliyar Wickremaratne concluded by expressing his sympathy and supporting the resolution.

III. The next item was the consideration of the Draft Report of the Committee appointed to consider the question of " How effectively the Central Board of Agriculture could be called upon to give advice to the Minister of Agriculture and Fisheries under the New Constitution."

The Chairman, while introducing the Report of the Sub-Committee to the Board said that his contribution to that report was very small and that the members of the Sub-Committee took a lively interest in the discussions that ensued at its sittings. The large attendance at the Sub-Committee meetings showed how interested the members were, in making suitable uggestions on the subject, to be submitted to the Minister. He said that it was indeed a great troke of luck that the Board was able to welcome Mr. Senanayake to listen to the discussion of he report. In spite of many other appointments including a meeting of the Board of Ministers

that morning, Mr. Senanayake had decided to be present at the last meeting of the present Central Board of Agriculture. He hoped that Mr. Senanayake would be able to advise the Board on the appropriateness of the suggestions in the Report and also give the Board some ideas in relation to its proposed set-up under the new constitution.

The Chairman then formally moved the adoption of the Report of the Sub-Committee.

A. E. Madawala Dissawa seconded.

Sir Wilfred de Soysa spoke next. Sir Wilfred said that he had devoted a great deal of time in order to see that when the new Parliament commences functioning the Central Board of Agriculture should be of greater usefulness to the Country than it had hitherto been. Hon. Mr. Senanayake was the Minister of Agriculture not only in the present Council, but in the last Council too. He had served as Minister for the last 16 years and as such he knew the exact working of the Department. He had taken a great personal interest in all that concerned the welfare of the inhabitants of this country and in the development of agriculture. Now with the establishment of the new form of Government it was very likely that the present Minister of Agriculture, Mr. Senanayake would not serve in the same capacity. He initiated this discussion in order to find out the views of other members of the Board. During some of the discussions it was revealed that everybody was of opinion that there should be greater co-ordination between the new Parliament and the Central Board of Agriculture. Sir Wilfred stated that under the new constitution the Minister of Agriculture might not be a member with an intimate knowledge of and concern for agricultural development as that displayed by Mr. Senanayake. In Britain the Minister consulted Farmers' and Farm Workers' Societies, but this Board was the only body in Ceylon that could give any form of advice to the future Minister. In order to clarify his position as regards that discussion, he had written to the Ministry of Agriculture and Fisheries, England, and had received the following reply :—

"MINISTRY OF AGRICULTURE AND FISHERIES,
55, Whitehall, S.W.I.
17th April, 1947.

Dear Sir,

You wrote on 30th March to Mr. Hensley, who has now left this office.

The Minister like his predecessors for many years past has made it his regular practice to consult the landowners', farmers' and farm workers' organizations of this country as well as the breed societies and the various technical, scientific and trade organizations associated with British Agriculture. The Secretary of State for Scotland and the Minister of Agriculture for Northern Ireland have adopted a similar policy as regards those countries.

Such consultation however is not only a preliminary to the drafting of new legislation or orders and regulations having statutory effect, but is a regular practice in matters requiring administrative and executive action. For instance, the Emergency Advisory Committee which the Minister has set up to advise, this Department on the steps to be taken to combat the effects on agriculture in Great Britain of the disastrous cold spell and recent heavy flooding includes representatives of the Central Landowners' Association, the National Farmers' Union, the National Union of Agricultural Workers, the Agricultural Section of the Transport and General Workers' Union and the Royal Agricultural Society of England, and has made a number of important recommendations which are now being put into effect.

The Minister also receives the help and advice of many specialists in the various fields of agriculture through the medium of *ad hoc* advisory committees such as the Sugar Beet Research and Advisory Committee, the Advisory Committee on Publicity, the

Rationing of Animal Feeding Stuffs Committee, the Agricultural Improvement Council, and a number of others. The members of these Committees are selected for their personal qualifications and experience, with the assistance of the various independent bodies concerned.

No payment is ordinarily made for the services of representatives who are not Government officials, apart from their travelling expenses and subsistence allowances according to the Treasury scale.

Yours faithfully,
(Sgd.) H. F. GREENFIELD,
Private Secretary."

Sir Wilfred felt that it would take at least another 10 or 15 years more for this Country to come up to the same state of development in agriculture. The Central Board of Agriculture was the only body which is constituted of personnel of the Department of Agriculture, as well as practical agriculturists of the country who were in a position to advise the Minister on various matters relating to agriculture. Sir Wilfred hoped that the Minister of Agriculture would consider the proposals put forward in the report and accept the recommendations of the Report of the Sub-Committee.

Mr. A. R. T. Gibbon speaking on the report said that at an earlier meeting a Sub-Committee of members who were interested in the subject were appointed and their recommendations mere contained in that report. Before he went into details, he welcomed Mr. Senanayake's presence at the meeting not so much as Minister, but as one who had shown great interest all his life in the agricultural development of this country and thereby safeguarded the interests of all who were dependent on agriculture for their livelihood and well being. When a person was liked very much by the people it was quite usual to give that person a pet name to show their affection and in like manner Mr. Senanayake was known as "Kele John." Mr. Gibbon welcomed him as a son of the soil. In connection with the proposals of the Report itself, he was glad that Mr. Senanayake himself was present because there were one or two points on which the members would look upon him for guidance and advice. He emphasized that every member of that Board met there with one particular view and that was to work for the furtherance of agriculture in this country, whether that member was from Hambantota, Batticaloa or Colombo. During the past 3 years they had all been a remarkably happy family and their discussions were quite free from political bias. Political discussions had their place in political organizations, but their main object was to give constructive advice on agricultural matters. Whether the Minister would be in office or whether someone else would succeed him in the new Parliament, he hoped that the Ministry would seek the advice of a body like the Board of Agriculture which would be of service to the Country. Mr. Gibbon added that Sir Wilfred was anxious to know how best the Board of Agriculture could serve in the absence of an Executive Committee in the new Parliament and inquired whether the new Minister was going to depend on the advice of technical advisers only. Sir Wilfred and some of the members were of opinion that although technical officers would give considerable advice, that was not sufficient and as such the Central Board should meet more frequently and give constructive advice on any matter the Ministry would refer to the Board. Sir Wilfred had explained and the other members would agree with him that the country was not sufficiently developed to depend on the advice of private bodies which could take the place of Government Organization which are now largely responsible for advising the peasantry. The members of the Sub-Committee had recommended that the personnel of the staff of Agricultural Instructors should be increased and an Agricultural Instructor should be stationed in the Province to train the peasantry in the art of conducting their meetings and discussing their problems which he said,

was an excellent scheme. Mr. Gibbon supported Sir Wilfred in his desire to strengthen the Board and formulate the proposals in the Report so that the Board could be of greater use to the community in general.

Dr. R. V. Norris, Director, Tea Research Institute, commenting on para. 2 of the Report of the Sub-Committee said that while it was fair comment that there were members on the Board who were not immediately familiar with village agriculture, he would put it to them that being people who could take a detached view of things, they could contribute something to the discussions of that body.

Commenting on para. 5 of the Report he said it has already been mentioned that some of the District Agricultural Committees did not function as they should. It had been mentioned that difficulty was experienced in calling up meetings and that to side-track the Board they were making representations to the Minister direct. He agreed that it would be very useful if their suggestions could come through some representative body.

Dr. Norris while agreeing with the view expressed in para. 7, supported Mr. Gibbon's suggestion that the higher authority or the Minister should refer to the Board occasionally for advice on agricultural matters.

Mr. K. Kanagasabai felt that until Provincial Councils were established all over the Island the co-ordination of technical services would not be satisfactory. He considered it one of the draw-backs of the Board that its work was not related to the various other services. In regard to the suggestion in para. 2 of the report that there should be 9 additional members each representing a province, to be ballotted for at the first meeting of the Board. Mr. Kanagasabai was at a loss to understand how the ballotting would take place among the members. Instead, he suggested that they be nominated by Government. Regarding the suggestion in para. 3 of the Report that the Chairman of the Divisional Agricultural Associations should not necessarily be Divisional Revenue Officers but should be elected from among the members, Mr. Kanagasabai was of the opinion that the D.R.O. should necessarily be the Chairman of the Divisional Agricultural Association and that the Agricultural Instructor of that area should be the Secretary, if satisfactory working of those associations was desired.

Mudaliyar Abulcassim Marakar said that the Board was really happy to welcome Mr. Senanayake with joy and jubilence because he was the creator of the Central Board of Agriculture and he was present just before the Board would cease to exist under the present constitution. Before he offered any comments on the report of the Sub-Committee, he said, he would like to make a few general observations relating to agricultural industry and to the Report of the Sub-Committee as well. Being aware of the fact that the services of the Executive Committee of Agriculture would no longer be available under the new Constitution he felt that the Central Board could replace that body, provided executive functions were assigned to the Central Board. He agreed that as rightly pointed out by the amiable Chairman, the Central Board was an Advisory body, but he wished to listen to the Minister on that particular point he had raised. Whether it was possible or not, to assign executive functions to the Central Board, the Board was composed of men of wide experience and intimate knowledge in matters pertaining to agriculture. Most of the members had a very intimate knowledge of agriculture and village agriculture in particular. The Board was prepared to offer the best advice and to render all possible assistance for the advancement and prosperity of the agricultural industry. He hoped that Mr. Senanayake would be invited in the newly elected House to form the Government of this country and to assume the office of Prime Minister. On behalf of the Board he requested Mr. Senanayake to see that the portfolio of Agriculture and Lands was entrusted to one of his colleagues who would be in a position to continue the good work done by Mr. Senanayake under the present Constitution. The agricultural felicity and prosperity of this country was entirely due to Mr. Senanayake's indefatigable efforts and his

farsighted policy. He hoped that under the new Constitution too Mr. Senanayake would be at the helm of affairs and safeguard the agricultural industry of this country. He expressed his desire to listen to Mr. Senanayake's observations as to how he proposed to reconstitute the Board under the Soulbury Constitution and thereafter under the Dominion Status Government.

Mudaliyar Abulcassim Marakar then made certain observations and suggestions on the Report of the Sub-Committee. He was interested in para. 3 of the Report dealing with District Agricultural Committees and the Divisional Agricultural Associations. If agricultural prosperity was desired, Divisional Agricultural Associations should be encouraged a great deal. He laid particular emphasis that steps should be taken to resuscitate the activities of the Divisional Agricultural Associations, the members of which were actual farmers and cultivators of land with an intimate knowledge of village agriculture. He suggested that in each Chief Headman's Division an Agricultural Instructor should be stationed to associate himself with the working of those associations and see that they functioned effectively. The District Agricultural Committee, no doubt, met at regular intervals but an officer of the Department was necessary to see to its proper working. He had in an earlier meeting of the Board suggested that an Agricultural Instructor should be stationed to each Chief Headman's Division and the Chairman had agreed with him in that connection.

Mudaliyar Abulcassim Marakar endorsed the observations made in para. 5 of the Report of the Sub-Committee that Resolutions of the District Agricultural Committees should be forwarded through the Central Board of Agriculture to the Minister, because it afforded the Board an opportunity to consider the merits and demerits of such resolutions before they reached the Minister.

Regarding para. 6 of the Report, he felt that it was better to have meetings of the Board monthly instead of bi-monthly.

Commenting on para. 7 of the Report he said that there was a feeling that nothing had been heard about resolutions passed by the Board and forwarded to the Minister. He recalled many instances when the Chairman had read out communications received from the Minister and his Executive Committee on some of the Resolutions passed, but he, however, was not certain whether such communications were received on all the resolutions passed by the Board. He emphasized that the desire of the Board to know from the Minister whether resolutions passed by the Board and forwarded to him were accepted or rejected, was quite immaterial.

Mudaliyar Abulcassim Marakar endorsed the recommendation in para. 9 of the Report—that the Director of Fisheries, the Commissioner for Co-operative Development and the Agricultural Officer, Propaganda, should be nominated to the Board of Agriculture—was a very useful suggestion.

In concluding his comments, he hoped that Mr. Senanayake would, in the future Constitution too, do his very best to further the agricultural industry of this country.

Mr. S. Sivapalan addressed the Board next. He said that Mudaliyar Abulcassim Marakar had gone through the Report of the Sub-Committee in detail and had commented on almost all the points but he would like to say a few words in reply to Mr. Kanagasabai who felt that the Government Agent should continue as Chairman of the District Agricultural Committee. The G. A. was made an ex-officio Chairman of the District Agricultural Committee when matters of importance relating to Agriculture were attended to by him. Furthermore the influence of the office of Government Agent was on the decline and there might be a time in the future when Kachcheries would disappear altogether. The Divisional Agricultural Officer was the person most conversant in matters pertaining to agriculture and was the most suitable person to preside over and to be placed in charge of the District Agricultural Committees. Secondly, the Agricultural Instructor who was to officiate in the near future as Secretary of those Associations,

worked directly under the Divisional Agricultural Officer who was in a better position to associate himself with the duties expected of the Agricultural Instructor than any other officer in his place.

Mr. Sivapalan also stressed the importance of the recommendation that the Chairman of the Divisional Agricultural Associations should not necessarily be Divisional Revenue Officers but should be elected from among the members, because there would be wider scope in many respects if a person other than the D. R. O. was elected Chairman. He remarked, in conclusion, that it was most advisable if the Board could adhere to the recommendations in the Report.

Col. T. Y. Wright next addressed the Board. He emphasized the importance of better liaison between the District Agricultural Committees and the Central Board of Agriculture. He agreed with Mr. Sivapalan that it was time to do away with Government Agents. He admired Mr. Senanayake for the work he had done for the agricultural advancement of the country and emphasized that he would like Mr. Senanayake, " Kele John " as people called him, to be the Minister of Agriculture although under the new Constitution, he would not continue in the same capacity.

Hon. Mr. D. S. Senanayake addressed the Board next. He said that he was present at the meeting that day, not with the intention of discussing the Report of the Sub-Committee nor to make any contribution to that Report. He felt that he should, on that occasion, perhaps the last occasion on which he as Minister of Agriculture would address the members of the Board, express his grateful thanks for all the assistance and the advice the Board had given him. From the discussions that ensued it looked as if the members of the Board were under the impression that they were to be buried and that the end of their time had come and that they did not know what their future was to be. But, as far as he could see, it was not the Board which had come to the end, but he had come to the end and he did not know what his future was to be. The Board was a statutory body which would continue to function till the Ordinances were amended. But what the Ordinance would be, he did not know. Merely, because a body was elected every three years it did not mean that for the rest of the period it would cease to exist. He assured the Board that the suggestions it had made would be carefully considered by the future Minister, whoever he might be, and decisions reached on those matters. But he was certain, whatever the decisions reached would be, it was only a fool who would not make use of willing gentlemen who represented the Board for advice, and hoped that the future Minister would want the services of the Board in whatever way its services could be given. He said he did not have the slightest grouse about the complaint made in that Report that no intimation was made by the Ministry as to whether or not resolutions passed by the Board were acceptable. The members of the Board were enthusiastic men, who were anxious to do their best for the cause of agriculture and in that desire there might have been proposals which they had put forward and they might feel that men of their capacity and willingness should have been able to achieve very much more and that the Ministry had not made sufficient use of their services. If there had been any such feeling, fault or shortcoming on his part, he regretted it very much. But at the same time he wished to stress that their advice had been well received by the Ministry and they had been of the greatest assistance to him. He acknowledged the good advice the Board had given him, and the assistance he had received, although he felt that something more could have been done. There was reference made in the Board that the Board was not receiving replies to any communication addressed to the Ministry. He emphasized that perhaps some members were under that impression, but if it was so, it was an unpardonable act of discourtesy on his part. He assured the Board that there was no such thing, either intentional or otherwise. If the minutes of the previous meetings of the Board were read, it would reveal that the Minister takes the advice of the Board and acts on that advice and issues instructions to the Director. There was no possibility of finding out what had been done unless they themselves inquired

after what the results of certain of their decisions were. He was, however, glad that one member who spoke earlier had remarked that communications of the Board had been acknowledged by the Ministry and replies had been sent many a time. If there had been an impression that the decisions of the Board had not received the consideration they should, he certainly regrettedit. About the main subject under discussion too there had been a sense of disappointment expressed. The Central Board of Agriculture accepted certain communications and resolutions from the District Associations and sometimes they did not function in the manner they ought to, and there was some reason for disappointment. As one member had expressed earlier he felt that there wasn't sufficient co-ordination between the District Committees, the Divisional Associations and the Central Board. He felt that that was due to one Board dealing with subjects concerning the whole of Ceylon whereas in other countries there were Boards for different purposes. There were Boards for Cattle Breeding, Agriculture and so on and a number of Committees. If that was attempted here he felt that men who were in close touch with different subjects under discussion could be consulted. Even the District Committee was a general body, and the Central Board was a general body and as such there wasn't that inducement or the desire to go in detail into matters concerning different problems. He emphatically stated that he was only giving the Board a reason for the lack of contact between District Committees, Associations and the Board. He regretted that it had happened so and hoped that in the future more advanced agriculturists could form the committees and work together in a better manner than they had done in the past. The other complaint he said was that the members felt that they were not consulted for advice on matters that came up before the Ministry. He emphasized that on more than one occasion he had sought the advice of the Board on matters that were engaging the attention of the Ministry and he had acted on such advice. He said that that kind of complaint only showed their desire or enthusiasm to do service to the country as they had done in the past. With regard to the many points raised he observed that in the future with the same co-operation and willingness they had shown to assist the Government and the Ministry they could get their views acted upon more speedily than had been done in the past.

He stressed that if the people of Ceylon expected Dominion Status very soon, they would certainly have to move faster than they were doing and emphasized that he had not the slightest doubt that they would do so. He also regretted that he had not been able to associate more closely with members of the Board owing to circumstances beyond his control. He, in conclusion, once again expressed his kind gratitude to the Board for all the assistance they had given him and hoped the same assistance would be given in the future too.

There was one other point he liked to mention and that was the constitution of the Central Board. He said he was responsible for getting up the Board. He also explained the constitution that existed before the Central Board came into being and some of the difficulties experienced in the past when important agricultural associations had to be consulted on various matters. He was referring not only to the difficulties experienced during the war period, but also to the period prior to that.

He finally concluded expressing his regret if there were any shortcomings on his part during the past period and his grateful thanks to the services of the Board.

The Report was accepted by the Board unanimously.

IV. ANY OTHER BUSINESS

Mr. C. A. M. de Silva speaking, emphasized that it had never given him so much pleasure as he felt on that occasion, to propose that the Board at its last meeting under the present constitution, should place on record its high appreciation of the invaluable services rendered to agriculture in special and to the general advancement of the Country as a whole by the Hon. the Minister for Agriculture and Lands, Mr. D. S. Senanayake. He stressed that to expatiate on the qualities of Mr. Senanayake before a body of agriculturists was like taking coal to New Castle.

Himself a practical agriculturist or as he would prefer to be styled a goiya, he had an uncanny way of solving agricultural problems. More outstanding than anything else, was Mr. Senanayake's grim determination when once convinced of the merits of a thing, to persist till success was achieved. Obstruction and obstructionists got short shrift from him not because he was not amenable to suggestion and correction but owing to his outstanding honesty of purpose and grim determination to see a good thing through. When on the threshold of Dominion Status it was well for everybody to scan their horizon and take stock of their position. That status and measure of responsibility was solely due to the selfless, untiring and unceasing efforts of Mr. Senanayake. In the present period of pseudo and semi pseudo leadership accompanied by banners, loud speakers, and noisy cat calls of unthinking dupes, the one man, the son of Lanka, who worked silently, unostentatiously and in Statesmanlike manner, to place Sri Lanka on an equal footing with other self governing countries, should not be forgotten. Blandishments of honours could not subordinate his ideals of Nationlism and his unswerving loyalty to the people of this country. Mr. De Silva in conclusion said—" He is our greatest, truest Nationalist, and under his wise and sagacious and experienced leadership it is not hard to fill the role of a Prophet."

Mr. De Silva then moved the following resolution :—

" That this Board is of the confirmed opinion that the invaluable services rendered to agriculture by The Hon. Mr. D. S. Senanayake, Minister for Agriculture and Lands, be perpetuated in a suitable manner and that a Sub-Committee of this Board be appointed to take such steps as are necessary to implement this resolution."

Mr. R. T. Chelliah seconded the resolution and complimented Mr. Senanayake for the invaluable services he had rendered in promoting the agricultural advancement of this country. He said that Ceylon was very fortunate when compared with other countries which were experiencing great hardship in procuring food. Mr. Senanayake's efforts on agriculture could be gauged if one cared to go to any village or district in the Island. He had introduced tractors and machinery to facilitate agriculture and a number of our agriculturists had been benefited.

Hon. Mr. D. S. Senanayake in reply, stated that he was very grateful to the mover of that resolution for the sentiments he had expressed. But as the Board was aware, he said, that they had just begun and that they were only laying the foundation for the future agricultural prosperity of the Island. Although it was suggested with the best of intentions, Mr. Senanayake wished if the latter portion of the resolution moved by Mr. De Silva could be omitted, viz. " that a Sub-Committee of this Board be appointed to take such steps as are necessary to implement that resolution." While requesting Mr. C. A. M. de Silva to withdraw the latter portion of that resolution he said that he would only ask them to give him a decent burial.

Mr. C. A. M. de Silva remarked that he was not in the habit of withdrawing what he says. but he was prepared to withdraw the last portion of the resolution if the Minister so desired, with the permission of the Board and the permission of the Seconder. Mr. De Silva, however, still felt that he should proceed with the whole resolution but at the same time he was not prepared to do anything contrary to Mr. Senanayake's wishes.

Gate Mudaliyar Wickremaratne addressed the Board next. He said he was a humble member of the Board for the last 14 years and he remembered the time when the first Board was inaugurated in 1905 by Sir Henry Blake, the then Governor. He recalled the time when Governors went about the country and spoke of the prosperity of the Island. He believed that since then, the agricultural prosperity of the Island could be gauged by the money that was spent on, and the amount voted for agriculture now. About 40 years ago people had not even heard of places like Parakrama Samudra, Minipe, Elehara, &c. When he was a schoolboy, he had read in books about those places and wondered whether they were mere myths. He had

a great desire to visit those places and he had done so before his retirement from service. He was very happy that those historical places and tanks were being restored once again in the same old splendour mainly on account of the efforts of Mr. Senanayake. He stressed that Mr. Senanayake's initiative and his untiring efforts had shown that what was mentioned in the Maha Vamsa about the agricultural prosperity of the Island and the great tanks, &c., were not mere myths but work that was praiseworthy and admirable.

Mudaliyar Wickremaratne had first come to know Mr. Senanayake about 40 years ago. He related an incident to show Mr. Senanayake's personal interest in agriculture when he had seen Mr. Senanayake in a paddy field with a pair of buffaloes clad only in a span cloth or " amude " as it was termed in Sinhalese. Mudaliyar Wickremaratne remarked that the declaration of an Englishman made long ago that with the mud washed off, a Sinhalese Cultivator was fit to sit on a throne had been fulfilled in person by Mr. Senanayake. He also complimented Mr. Senanayake for the present system of allocating lands to villagers by acquiring crown and private lands which were their's originally and for providing them facilities for cultivation by restoring neglected tanks, &c. He concluded wishing that Mr. Senanayake would continue in the same spirits his efforts on the agricultural improvement of the country in the future too.

Mr. Sivapalan felt that they would be wanting in their duty if they did not make any reference to the guidance and the co-operation received from the President of the Board and the Secretary. They had had heated arguments, sometimes never ending and the Chairman had acted very wisely. The Chairman had been very kind and amiable and had conducted their discussions very efficiently. The Board had always dispersed very happily after its meetings wishing to assemble again in the same spirit. Just as the Chairman, the able Secretary had also given them full co-operation and assistance and complimented him for his useful services to the Board.

A hearty vote of thanks was proposed by Mr. Sivapalan in appreciation of the services of the President and the Secretary of the Board.

Mr. Bandara Dharmakirti seconded.

The Chairman thanked the Board for the very considerate manner in which they had assisted him during the 3 years to carry out the functions of the Board which were very difficult in many respects. When he first came to the Department he was quite new to the work and was not very conversant with the functions of the Board. The first meeting of the Board was held when he was not even 2 months in the Department and he remembered that on that occasion Mr. Gibbon had raised some pertinent questions when he had given some impertinent answers, but they remained good friends throughout.

The meeting terminated at 4·30 P.M. followed by a Tea Party at which the Hon. Mr. Senanayake, the members and the visitors were the guests of Mr. and Mrs. L. J. Seneviratne.

M. J. PERERA,
Secretary, Central Board of Agriculture.

Peradeniya, July 12, 1947.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON, HELD AT THE OFFICE OF THE PLANTERS' ASSOCIATION OF CEYLON, COLOMBO, ON FRIDAY, SEPTEMBER 26, 1947

Present.—Mr. R. C. Scott, C.B.E. (Chairman); The Director of Agriculture (Mr. L. J. de S. Seneviratne, C.C.S.); The Chairman, Planters' Association of Ceylon (Mr. W. A. Paterson); The Chairman, Agency Section, Planters' Association of Ceylon (Mr. D. F. Ewen); Messrs. W. H. Attfield, F. Amarasuriya, S. Vytilingam, W. W. A. Phillips and Dr. R. V. Norris (Director and Secretary).

Apologies for absence were received from the Honourable The Financial Secretary and Messrs. G. K. Newton and W. H. Gourlay.

1. **THE NOTICE CONVENING THE MEETING WAS READ**

2. The Minutes of the Meeting of the Board held on May 19, 1947, were confirmed subject to a minor verbal correction in the names of those present.

3. **MEMBERSHIP OF THE BOARD AND COMMITTEES**

(*a*) Reported that Mr. R. Singleton-Salmon, having resigned the office of the Chairman of the Planters' Association of Ceylon, had been succeeded as an ex-officio member by Mr. W. A. Paterson, the new Chairman, with effect from August 21.

(*b*) Reported that Mr. C. A. Meakin had been succeeded as an ex-officio member by Mr. D. F. Ewen, the new Chairman of the Agency Section of the Planters' Association of Ceylon.

The Chairman welcomed Messrs. Paterson and Ewen to the Board and asked the latter to record their thanks to Messrs. Salmon and Meakin for their services to the Institute.

4. **FINANCE**

(*i*) *Audited Accounts of the Institute for 1946.*

These had been circulated to Members, and the Chairman quoted some of the salient figures. Mr. Scott said the accounts and the auditors' reports thereon, which were of the usual satisfactory nature, had been considered by the Finance Committee and recommended for adoption.

In regard to insurance, the Chairman said at present the factory and connected buildings were insured at replacement value. Other buildings were, however, insured at cost value. Although the risk of fire in these buildings was exceedingly low the Finance Committee had recommended that all major buildings, in view of the greatly increased cost of building, should be covered at replacement value. The Board approved this recommendation.

The Chairman also mentioned that a minor adjustment should be made under depreciation, as by inadvertence the T. R. I. car had been depreciated at 10 per cent. of its value only instead of 25 per cent. This matter would be adjusted in the 1947 accounts.

The Chairman reported that the interest and capital repayments due on the Government Loan had been met and the outstanding balance of the loan as at December 31, 1946, was Rs. 428,017. The loan would be extinguished in 1953.

The accounts were then approved on the proposal of Mr. Phillips seconded by Mr. Paterson.

The Director of Agriculture asked that in future the Auditors' report, and not only the audited accounts, should be issued to all members of the Board as well as to the Finance Committee. The Chairman agreed to do this.

(*ii*) *Accounts of the Junior Staff Provident Fund and Medical Fund.*

The above were approved by the Board.

(*iii*) *T. R. I. Accounts to July 31, 1947.*

Reported that the cess to the above date was approximately Rs. 10,000 less than to the same date in 1946. This was due to a hold up in exports due to the harbour strike in June.

The Chairman referred to the profit on St. Coombs estate which at July 31, was Rs. 14,822 with some 64,000 lb. of manufactured tea awaiting sale. In these circumstances, it seemed certain, the profit for the year would greatly exceed that for any previous year.

In reply to Mr. Phillips, who commented on the food stocks held on the estate, the Director said these were disinfected from time to time and no material loss was anticipated. No difficulty had been experienced in disposing of rycena, but Mr. Daniel's attention would be called to the somewhat high reserves of this food.

The accounts were accepted.

(*iv*) *Additional Votes.*

The following additional votes were sanctioned after the Director had given details to the Board :—

(*a*) *Estate Working Account.*—

Rs. 700 for salary of a Storekeeper-overseer.
Rs. 1,000 for engine repairs.
Rs. 750 for machinery upkeep.
Rs. 2,100 for cost of resurvey of St. Coombs.
It was decided to refer to the Auditors the question as to whether this should be debited to working account or to capital expenditure.

(*b*) *Estate Capital Account.*—

Rs. 8,500 for a Direct-fired heater and burner for the E. C. P. drier.
Rs. 5,500 for a new blower.

(*c*) *Research Revenue Account.*—

Vote 32—Experimental manufacture.—Rs. 1,000 to cover the cost of the patent taken out by the Board.

Vote 39—Travelling of Staff.—Rs. 1,494 to meet the cost of the visit to South India by the Director and Dr. Tubbs.

(*d*) *Research Capital Account.*—

Water Supply.—Rs. 4,450 for a new pump and motor.
Field Experiments, Agricultural Chemist.—Rs. 1,600 for three weighing-in sheds on the exprimental plots.
Buildings.—Rs. 75,000 to meet the cost of the three Junior Staff Bungalows.

(*v*) *Government Loan.*—

Reported that a payment of Rs. 75,316 due on the Government loan had been duly met on September 25. This was made up of Interest Charges Rs. 23,541 and Repayment of capital Rs. 51,775.

5. **AMENDMENTS TO THE TEA RESEARCH INSTITUTE ORDINANCE**

Reported that the draft amendments approved by the Board had been duly forwarded to Government and would come up before the new Parliament in due course.

6. FUTURE DEVELOPMENT OF THE INSTITUTE AND T. R. I. CESS

The Chairman said he had been going into this matter with the Director. Originally, it had been decided to refer this matter to the Experimental Committee. In view of the large amount of detailed work to be carried out, he thought the Experimental Committee was too large for this purpose and he suggested that a special committee should be appointed. This Committee would consider in detail the future experimental policy and the consequent requirements of the Institute and Estate in regard to staff, buildings and finance. It would also review the salaries and conditions of service of all grades of the Institute's staff. The proposals made by the Committee could then be referred to the Experimental Committee for comment before being submitted to the Board.

The Board approved the above proposal and appointed the following committee to deal with these questions :—The Chairman, T. R. I.; The Director T. R. I.; The Chairman, Planters' Association of Ceylon, and Messrs. Vytilingam, Phillips and Gourlay.

7. STAFF OF THE INSTITUTE

(*i*) *Director.*—The Chairman informed the Board that the Director's present agreement would expire in August, 1948. It was decided that the question should be considered by the Board at the December meeting.

(*ii*) *Senior Staff.*—

Entomologist. Reported that Dr. C. H. Gadd had proceeded on eight months leave on May 10.

(*iii*) *Junior and Sub-Staff.*—

(*a*) The Board sanctioned an advance of Rs. 2,000 for the purchase of a car for Mr. W. T. Fonseka of the Passara Sub-Station, this sum to be recovered in monthly instalments of Rs. 50.

The Board asked the Committee appointed under item 6 above to consider generally the question of the provision of cars for those officers whose work involves continuous travelling.

(*iv*) *Small Holdings Officer.*—

The Chairman said 171 applications had been received for the vacant post and these were being scrutinized. The Board authorised the Chairman and the Director to make the final selection.

8. ST. COOMBS ESTATE

The Visiting Agent's report dated July 30, had been issued to the Board but the Chairman mentioned that this had not yet been considered by the Experimental Committee.

The Chairman called attention to the revised acreage of the estate as revealed by the recent survey. After allowing for buildings and roads, &c., the acreage of old tea, at 291 acres, was now nine acres less than previously shewn. Yields would in future be based on the revised acreage.

The Director was asked to consider in the Experimental Committee the out-turn of pruners and the work done by these workers.

Favourable comment was made on the figure for made tea per factory cooly and the plucking average.

In reference to weeding, the Director stated that, now the new survey had been completed, it was hoped to arrange for family weeding contracts on small plots.

In reply to Mr. Attfield, the Director said, a number of bushes had been found on St. Coombs which appeared to be relatively resistant to blister blight. These were being multiplied for more detailed tests.

Reported that the crop figure to August 30 was 23,400 pounds in excess of the 1946 figure in spite of very unfavourable weather in August.

No serious damage had occurred on the estate during the August floods though falls of 8·40 and 5·31 had occurred on the 14th and 15th.

9. BLISTER BLIGHT

The Chairman reported that the Director and Dr. Tubbs had, in reponse to an invitation from the United Planters' Association of South India, visited South Indian tea districts in August to discuss the Blister blight position.

Dr. Norris said he and Dr. Tubbs had, in addition to attending U. P. A. S. I. meetings in Coonoor, visited the Nilgiris, the High Range and the Anamallai's Districts. They had also had the opportunity of meeting Mr. Harrison, the Director of the Tocklai Experimental Station, Mr. Manning, the U. P. A. S. I. Scientific Officer, and Mr. Mayne, the Scientific Officer of the Kanan Devan Hills Produce Co., in the High Range, Travancore.

South India had originally hoped to eradicate the disease before it spread throughout the tea areas and legislation had been hurriedly passed to enforce various details of treatment. The idea of eradication had proved quite illusory and it was not proposed to renew the above legislation when it lapsed at the end of 1947.

It might be said that, in general, South India was now following the methods which had been suggested by the T. R. I. to meet Ceylon conditions. Attacks had been severe in South India but the general picture closely resembled that found in Ceylon. Both Dr. Tubbs and himself were satisfied from what they had seen that the measures recommended by the T. R. I. were sound.

Dr. Norris said a short report on the visit would be issued to the Board as soon as possible.

Referring to the Blister blight position in Ceylon, Dr. Norris said that there had naturally been an increase in attacks following the recent wetter weather. Fortunately the weather had been characterized by breaks of sunny days and these had so far limited the severity of attack where reasonable precautions had been taken. Certain estates which had ignored the Institute's advice and pruned on into the wet weather had certainly suffered severe loss. Generally speaking, however, losses due to Blister blight had been masked by favourable growing weather.

Correspondence with the Ceylon Association in London in connection with Blister blight was tabled.

10. MANUFACTURE

The Chairman reported that the application by the Board for a Ceylon patent covering recent work on the manufacture of tea from unwithered leaf had been granted.

11. REPORT OF THE BOARD FOR 1946

The Board approved the draft of the Report prepared by the Director.

12. ANY OTHER BUSINESS

(*a*) The Board gave formal approval for the fixing of the seal to Mr. Daniel's agreement.

(*b*) The Board approved the recommendation of the Finance Sub-Committee that for the 1948 estimates the cess should be based on exports of 270,000,000 pounds of tea and that the profit on St. Coombs estate for 1948 should be estimated at Rs. 75,000.

(*c*) It was decided that the next meeting of the Board should be held at St. Coombs, between December 10 and 15.

The Meeting then concluded with a vote of thanks to the Chair.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakele, October 31, 1947.

ROLAND V. NORRIS,
Secretary.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE EIGHTY-FIFTH MEETING OF THE RUBBER RESEARCH BOARD, HELD AT THE SECRETARIAT, COLOMBO, AT 2.30 P.M. ON MONDAY, NOVEMBER 3, 1947

Present.—Mr. D. Rhind (in the Chair), Mr. T. D. Perera, C.C.S. (Deputy Secretary to the Treasury), Mr. Simon Abeywickrema, M.P., Mr. T. Amarasuriya, Mr. W. H. Attfield, Mr. W. Neal de Alwis, J.P., Mr. W. P. H. Dias, J.P., Mr. A. M. Clement Dias, Mr. Noel de Silva, The Hon. Mr. G. E. de Silva, M.P., Mr. T. C. A. de Soysa, Mr. F. H. Griffith, M.P., Mr. R. J. Hartley, Mr. A. D. Layton, Mr. R. C. L. Notley, Mr. F. A. Obeyesekere and Col. J. T. Young.

Dr. E. Rhodes, Director, was present by invitation.

Before commencing the business of the meeting the Chairman announced that as Director of Agriculture he had assumed duties as Chairman of the Board on October 20, 1947.

1. MINUTES

Draft minutes of the meeting held on July 28, 1947, which had been circulated to members, were signed by the Chairman on signification of members' assent that they were in order.

2. DRAFT ESTIMATES FOR 1948

Draft estimates providing for income and expenditure as follows were approved :—

	Rs.	Rs.
Income		441,412
Expenditure—		
Revenue	478,628	
Capital	52,495	
		531,123
Excess of expenditure over income ..		89,711

It was noted that the Scheme's reserves would be extinguished in 1948 and a Sub-Committee consisting of the Chairman, the Director and the Treasury representative was appointed to consider the Scheme's finances and place before the Board proposals for continuing the work of the Scheme stating the minimum staff and funds required.

3. DECISIONS BY CIRCULATION OF PAPERS

Reported that the Chairman's proposals regarding resolutions passed at meetings had been approved.

4. CONFIRMATION OF DECISIONS AT LAST MEETING

Decisions at the last meeting in respect of items which had not been on the agenda were confirmed and it was also agreed that an annual questionnaire be issued to estates with the object of acquiring information regarding the incidence and effects of Oidium in the various districts.

5. **BOARD**

The following changes in membership were reported :—

(*a*) Mr. F. H. Griffith, M.P., had resumed membership with effect from August 22, 1947, relieving Mr. J. D. Farquharson who had been acting for him.

(*b*) Mr. T. D. Perera, C.C.S., Deputy Secretary to the Treasury, had been nominated to represent the Minister of Finance with effect from October 23, 1947, in place of Mr. H. E. Peries, C.C.S.

Messrs. Griffith and Perera were welcomed to the Board and Messrs. Farquharson and Peries thanked for their services.

6. **EXPERIMENTAL COMMITTEE**

Recommendations made at meeting held on October 2, 1947 :

(*a*) *Visiting Agent.*—The recommendation that the post of Visiting Agent be offered to Mr. W. A. Paterson at an increased fee was approved.

(*b*) *Staff.*—The resignations of the Estate Superintendent, Conductor, and Head Estate Clerk were accepted and the Director's proposals for the future working of the estates were approved.

Mr. Amarasuriya left the meeting.

(*c*) *Extension of Hedigalla cart road.*—Agreed that the work be done on estate account after approval by the Experimental Committee.

Messrs. Abeywickrema and Hartley left the meeting.

(*d*) *Construction of two junior staff bungalows at Hedigalla.*—Agreed that W. J. de Silva's tender be accepted and a contract awarded to him for the construction of two junior staff bungalows at Hedigalla.

The minutes were adopted.

7. **REPORTS AND ACCOUNTS**

(*a*) *Director's report for the 2nd quarter, 1947*—was approved.

(*b*) *Estate accounts for May and June, 1947*—were tabled.

(*c*) *Balance Sheet and Auditor's Report for 1946*—were adopted.

(*d*) *Research Programmes for 1948*—was approved.

8. **STAFF**

(*a*) *Mycologist.*—A letter from Mr. C. G. Hansford giving notice of resignation was read and its contents noted with regret.

(*b*) *Chemist.*—It was noted with regret that Mr. M. W. Philpott's service agreement which was due to terminate in June, 1948, might not be renewed as he had received an offer of employment on better terms elsewhere.

(*c*) *Junior Staff*—

Changes in staff were reported.

9. **LONDON ADVISORY COMMITTEE**

Minutes of meetings of the Committee and the Technical Sub-Committee held on June 27 1947—were tabled.

10.—CORRESPONDENCE WITH THE DIRECTOR OF COMMERCE AND INDUSTRIES

A request from the Director of Commerce and Industries for temporary laboratory facilities at Dartonfield for two Laboratory Assistants of the Rubber Technologist's Department was considered and approved.

11.—PUBLICATIONS

The following publications were tabled :—

Advisory Circular No. 26.

Combined 1st and 2nd Quarterly Circular for 1947.

The meeting terminated with a vote of thanks to the Chair.

Dartonfield,
Agalawatta, November 24, 1947.

C. D. de FONSEKA,
Secretary-Accountant.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE EIGHTY-SIXTH MEETING OF THE RUBBER RESEARCH BOARD, HELD AT THE CEYLON CHAMBER OF COMMERCE, COLOMBO, AT 10 A.M. ON MONDAY, DECEMBER 15, 1947.

Present.—Mr. D. Rhind (in the Chair), Mr. H. E. Peries, C.C.S. (Representing the Deputy Secretary to the Treasury), Mr. Simon Abeywickrema, M.P., Mr. W. H. Attfield, Mr. W. Neal de Alwis, J.P., Mr. C. A. C. Bowen, Mr. W. P. H. Dias, J.P., Mr. A. M. Clement Dias, Mr. Noel de Silva, Mr. T. C. A. de Soysa, Mr. F. H. Griffith, M.P., Mr. R. C. L. Notley, Mr. F. A. Obeyesekere, and Col. J. T. Young.

Dr. E. Rhodes, Director, was present by invitation.

The Chairman read an apology for absence from Mr. R. J. Hartley.

1. MINUTES

Draft minutes of the meeting held on November 3, 1947, which had been circulated to members, were signed by the Chairman.

Messrs. Neal de Alwis and Simon Abeywickrema came into the meeting.

2. BOARD

(*a*) The Chairman reported that Mr. C. A. C. Bowen, representing the R. G. A., had resumed membership with effect from November 27, 1947, relieving Mr. A. D. Layton who had acted for him.

(*b*) The Chairman spoke of the services rendered to the Board by his predecessor, Mr. L. J. Seneviratne, who had served as Chairman from February 14, 1944, until October 20, 1947. A unanimous vote of thanks was passed by the Board for the valuable services which he had rendered.

3. FINANCE

(*a*) *Report of Finance Committee.*—The Committee's report was adopted subject to the amendment that the increased cess to be asked for should be 50 cents per 100 lb. instead of 33⅓ cents. Agreed that the support of the Planters' Association of Ceylon and the Low Country Products Association be sought and the report then presented to the Hon. the Minister of Agriculture and Lands by a deputation consisting of five members of the Board, the Chairman and the Director.

(*b*) *Contribution to London Advisory Committee.*—Agreed that the contribution for 1948 should be £2,000.

4. REPORTS

(*a*) *Director's report for the 3rd quarter, 1947*—was approved.

(*b*) *Inventory report for 1946*—was approved.

(*c*) *Comments on Report of the Rubber Commission*—Draft comments prepared by the Director were approved for transmission to the Minister.

5. **STAFF**

(*a*) *Re-engagements.*—Agreed that Mr. C. A. de Silva, Botanist, Mr. W. I. Pieris, Smallholdings Propaganda Officer, and Dr. L. A. Whelan, Soil Chemist, be offered re-engagement on the termination of their contracts.

(*b*) *Chemist.*—Appreciation of the very valuable services rendered to the Scheme by Mr. M. W. Philpott, Chemist, who had resigned to accept a post in Malaya, was recorded.

(*c*) *Junior Staff.*—Changes in staff were reported.

6. **STATEMENT OF RECEIPTS AND PAYMENTS FOR THE SECOND QUARTER, 1947, WAS APPROVED.**

The meeting then terminated.

Dartonfield,
Agalawatta, January 16, 1948.

C. D. de FONSEKA,
Secretary-Accountant.

COCONUT RESEARCH SCHEME (CEYLON)

BOARD OF MANAGEMENT

MINUTES OF THE NINETIETH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT 10.30 A.M. ON MONDAY, DECEMBER 1, 1947, AT BANDIRIPPUWA ESTATE, LUNUWILA.

Present.—Mr. D. Rhind (Director of Agriculture), Chairman, Mr. C. A. M. de Silva (Chairman, L. C. P. A.), Mr. A. Pearson (Representing the P. A. of Ceylon), Mr. E. Muttucumaru (Representing the P. A. of Ceylon), Mr. C. E. L. de Silva (Representing the L. C. P. A.), Mr. G. Panditesekera, J.P., U.M. (Representing the Smallholders), Dr. Reginald Child (Director), Mr. S. C. Kahawita (Secretary).

Apologies for absence were received from Mr. T. D. Perera, Deputy Secretary to the Treasury, from Mr. D. D. Karunaratne, J.P., M.P., and from Mr. Vernon Rajapakse.

1. MINUTES

Minutes of the previous meeting held on September 22, 1947, which had been circulated were confirmed.

2. CORRESPONDENCE

(*a*) A letter from Mrs. N. Jayawickrama, in acknowledgment of the vote of condolence, passed at the 88th meeting on the death of her father, Mr. S. F. H. Perera, was tabled.

(*b*) The Chairman reported to the Board that he had been informed by the Hon. Minister for Agriculture and Lands that action is being taken to nominate two members to the Board from the Senate and the House of Representatives.

3. BOARD

Mr. C. A. M. de Silva in proposing a vote of thanks to the following out-going members :

Mr. L. J. de S. Seneviratne (Acting Director of Agriculture), (Chairman,)

Mr. H. E. Pieris (Deputy Financial Secretary),

Mr. Stanley Dias,

Mr. Thomas Amarasuriya, and

Mr. J. Tyagarajah,

expressed the Board's appreciation of the manner in which the previous Chairman, Mr. L. J. de S. Seneviratne had conducted the business of the Board.

Mr. G. Panditesekera seconded.

The Director in associating himself with the resolution added that the present sound financial position of the Scheme was due mainly to the personal efforts of Mr. Seneviratne. The resolution was carried with acclamation.

It was decided to send a copy of this resolution to Mr. L. J. de S. Seneviratne.

(*b*) Mr. C. A. M. de Silva, on behalf of the Board welcomed the new members, Mr. D. Rhind, Chairman, T. D. Perera, Deputy Secretary to the Treasury, and Mr. C. E. L. de Silva, the L. C. P. A. Representative. He referred to the Chairman's wide experience in Burma and elsewhere, which would be of benefit to Ceylon.

This resolution was seconded by Mr. E. Muttucumaru, and carried *nem. con.*

(*c*) The Chairman on behalf of the Board congratulated Mr. C. A. M. de Silva on being nominated to the Senate, and Mr. D. D. Karunaratne, J.P., on being elected to the House of Representatives. Mr. G. Panditteseker, as the oldest member, added his congratulations.

4. STAFF

(*a*) *Research Assistant to the Botanist.*—The Board decided, after considerable discussion, to accept the Director's suggestion to offer the post to the present Technical Assistant, Mr. D. V. Liyanage, who had (the Director reported) just obtained his London (External) B.Sc. degree by private study.

The Director was authorised to advertise the post of Technical Assistant to the Botanist on the existing terms and conditions of service and to make a suitable appointment.

5. SUB-COMMITTEES

Mr. C. E. L. de Silva was nominated to the Estate Sub-Committee in place of Mr. Stanley Dias, the retiring member.

6. EXPERIMENTAL PROGRAMME

This had been circulated and was tabled. In connection with the Advisory Division the Board authorised the appointment of a number of field officers (not exceeding six for the present) to be taken on as the exigencies of work required, especially in connection with advisory service to the Co-operative Sales Societies.

7. ANNUAL REPORTS

(*a*) It was reported that the Annual Report for 1944 which had been circulated was now in the hands of the printers.

(*b*) The annual report for 1945 which had been circulated was tabled.

(*c*) The annual report for 1946, the Director said was in manuscript form and would be circulated as soon as the Audit Report is received.

8. SOIL CHEMIST'S STUDY LEAVE

(*a*) With the permission of the House, the Chairman took up the question of the Soil Chemist's study leave. A course of study involving considerable travelling in India had been submitted; in present circumstances the Chairman did not consider it advisable or even practicable to undertake this. He referred to the Soil Science Congress to be held in England in June, 1948 (which was being attended by two officers of the Department of Agriculture), and thought that the Soil Chemist might well attend this Congress in place of the proposed Indian visits. The Board agreed that provisional arrangements for passages to and from England in 1948 should be made, and that further particulars should be afforded for discussion at the next meeting.

(*b*) It was decided to hold the next meeting in Colombo, on Monday, January 26, 1947, at 2.30 P.M.

The meeting concluded at 12.55 P.M. with a vote of thanks to the chair.

By order,

S. C. KAHAWITA,

Secretary, Coconut Research Scheme.

Bandirippuwa Estate.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED OCTOBER 31, 1947

Province	Disease	Fresh cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to Oct. 31, 1947			
				Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplamosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	8	124	124	—	—	—
Colombo Cattle Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	—	31	31	—	—	—
Northern Province	Foot-and-mouth	—	980	89	891	—	—
	Rabies	—	6	—	—	—	6
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	—	41	14	27	—	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Sabaragamuwa Province	Foot-and-mouth	—	933	98	835	—	—
Southern Province	Foot-and-mouth	82	547	5	460	82	—
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	—	3	3	—	—	—
	Piroplasmosis	—	19	1	18	—	—
	Rabies	2	4	4	—	—	—
	Haemorrhagic Septicaemia	—	34	34	—	—	—
Eastern Province	Foot-and-mouth	—	2,797	135	2,662	—	—
Uva Province	Foot-and-mouth	—	2,012	70	1,942	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, November 17, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED NOVEMBER 30, 1947

Province	Disease	Fresh cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to Nov. 30, 1947			
				Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Rabies	9	133	133	—	—	—
Cattle Quarantine Station, Colombo	Foot-and mouth	—	18	—	18	—	—
	Anthrax	—	31	31	—	—	—
Northern Province	Foot-and mouth	—	980	89	891	—	—
	Rabies	—	6	—	—	—	6
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (goats)	—	41	14	27	—	—
	Foot-and mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Sabaragamuwa Province	Foot-and-mouth	—	933	98	835	—	—
Southern Province	Foot-and-mouth	515	1,062	6	971	82	3
	Rabies	—	4	1	—	—	3
	Black Quarter	—	6	6	—	—	—
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	—	3	3	—	—	—
	Piroplasmosis	—	19	1	18	—	—
	Rabies	1	5	5	—	—	—
	Haemorrhagic Septicaemia	—	34	34	—	—	—
Eastern Province	Foot-and-mouth	—	2,797	135	,662	—	—
Uva Province	Foot-and mouth	—	2,012	70	1,942	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, December 20, 1947.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED DECEMBER 31, 1947

Province	Disease	Fresh cases during the month	Cases up to date since Jan. 1, 1947	From Jan. 1, 1947 to December 31, 1947			
				Deaths	Recoveries	Balance ill	No. shot
Western Province	Foot-and-mouth	—	236	17	219	—	—
Colombo Municipality	Piroplasmosis	—	2	2	—	—	—
	Foot-and-mouth	—	3	—	3	—	—
	Tuberculosis	—	1	1	—	—	—
	Lynphangitis	1	1	1	—	—	—
	Rabies	7	140	140	—	—	—
Colombo Quarantine Station	Foot-and-mouth	—	18	—	18	—	—
	Anthrax	—	31	31	—	—	—
Northern Province	Foot-and-mouth	—	980	89	891	—	—
	Rabies	3	9	—	—	—	9
North-Western Province	Rabies	—	1	1	—	—	—
	Mange (Goats)	—	41	14	27	—	—
	Foot-and-mouth	—	24	22	2	—	—
North-Central Province	Foot-and-mouth	—	141	—	141	—	—
Sabaragamuwa Province	Foot-and-mouth	—	933	98	835	—	—
Southern Province	Foot-and-mouth	—	1,062	6	1,053	—	3
	Black Quarter	—	6	6	—	—	—
	Rabies	1	5	2	1	—	3
Central Province	Foot-and-mouth	—	999	2	997	—	—
	Anthrax	1	4	4	—	—	—
	Piroplasmosis	3	22	1	21	—	—
	Haemorrhagic Septicaemic	—	34	34	—	—	—
	Rabies	4	9	9	—	—	—
Eastern Province	Foot-and-mouth	—	2,797	135	2,662	—	—
Uva Province	Foot-and-mouth	—	2,012	70	1,942	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry), and
Government Veterinary Surgeon.

Peradeniya, January 22, 1948.

METEOROLOGICAL REPORT, OCTOBER, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	85·0	—0·7	71·6	—0·8	85	98	7·6	26·39	21	+ 7·63
Anuradhapura	88·3	—0·6	72·8	—0·7	73	95	6·6	13·98	13	+ 4·26
Badulla	81·8	—1·0	65·3	—0·2	76	95	5·4	9·36	16	+ 0·47
Batticaloa	86·1	—0·9	74·6	—0·6	80	90	6·6	5·44	11	— 1·75
Colombo	84·3	—0·6	74·5	—0·3	82	88	7·8	11·41	17	— 2·30
Diyatalawa	76·0	—0·3	59·5	—1·2	77	91	6·3	8·40	18	— 0·78
Galle	82·5	—0·5	74·9	—0·6	86	93	6·2	14·43	18	+ 2·38
Hakgala	70·0	—0·1	57·2	+1·3	76	81	6·4	9·05	16	— 2·23
Hambantota	85·6	—0·6	74·8	—0·5	80	88	8·1	2·09	12	— 2·67
Jaffna	85·2	—0·5	76·8	—0·7	79	88	5·8	10·97	10	+ 1·77
Kandy	83·5	—0·7	67·8	—0·7	80	95	6·7	16·00	18	+ 5·46
Kurunegala	85·9	—1·5	72·1	—1·1	78	93	6·8	12·19	16	— 2·67
Lunuwila	84·3	—1·4	73·9	—0·3	83	95	6·9	6·91	15	— 3·98
Mannar	86·1	—0.9	76·6	—0·6	78	86	6·2	6·05	9	— 0·53
Nuwara Eliya	67·4	—0·2	50·8	—1·2	80	87	8·0	10·14	16	+ 0·38
Puttalam	85·8	—0·5	74·8	—0·8	78	90	5·3	5·72	9	— 1·71
Ratnapura	85·1	—2·1	72·1	—0·8	80	94	6·5	24·68	19	+ 6·67
Talawakele	72·9	—0·5	57·0	—0·8	84	91	6·2	13·14	17	+ 3·08
Trincomalee	87·0	—0·8	74·9	—0·7	78	89	6·9	12·18	10	+ 2·63

Rainfall in October was irregularly distributed on either side of average. Larger excesses (of the order of 5 to 10 inches or more) occurred chiefly on the south-western slopes of the hills, the neighbouring mid-country and in Jaffna Peninsula, the highest being 14·27 inches at Kankesanturai, 12·08 inches at Kellie Estate, 11·43 inches at Norton Bridge and 11·19 inches at Kanana Estate. Larger deficits (of the order of 2 to 5 inches) occurred mainly in the adjacent parts of Western and North-Western Provinces, in Batticaloa District and in scattered places to the east of the hills. The largest deficits were 8·40 inches at Tanamalwila and 7·23 inches at Illukkumbura.

Rainfall was heaviest on the south-western slopes of the hills where Norton Bridge recorded a total of 35·59 inches for the month, Kellie Estate 34·63 inches and Blackwater Estate 34·51 inches. There was also comparatively heavy rain in Jaffna Peninsula, *e.g.*, 23·89 inches at Kankesanturai. Least rain was experienced along the south-east coast and in the southern parts of Batticaloa District, monthly totals generally ranging from 2 to 5 inches.

There were 32 daily falls of 5 inches or over during the month, most of them occurring between the 18th and the 23rd. The highest were 9·72 inches both at Hendon Estate on the 13th, and at Pomparippu on 23rd and 9·13 inches at Kankesanturai on the 22nd.

There was very little rain up to the 7th. Increased rainfall in the south-west of the Island, and a fairly marked south-westerly gradient during the period 8th to 10th were connected with the existence of a trough of low in Central Bay of Bengal.

Fairly widespread rain and thunderstorm activity were prevalent from 14th to 17th. About the 19th the pressure fell, and the Island came under the influence of a trough of low that formed in the extreme South Bay of Bengal. A depression, first identified on the 21st, rapidly developed into a severe cyclonis storm by the next day. The storm moved away in a northerly direction, and by the 24th the Island wa, completely outside its range of influence. Very heavy widespread rain fell during the period 20th to 23rd, while frequent westerly or north-westerly squalls were experienced on the west coast.

Dry weather prevailed during the last week of the month.

Temperatures were below average. The highest recorded shade temperature was 95·6° at Anuradhapura on the 2nd, while the lowest air temperature was 39·7° at Nuwara Eliya on the 25th. Humidities were mostly above average. Winds were mainly south-westerly.

D. T. E. DASSANAYAKE,
Superintendent, Observatory.

METEOROLOGICAL REPORT, NOVEMBER, 1947

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	89·2	+3·0	70·3	—1·4	76	97	5·0	8·65	14	— 9·87
Anuradhapura	87·9	+2·5	69·0	—2·8	74	93	5·4	3·99	11	— 6·68
Badulla	80·5	+1·3	63·5	—2·2	69	94	4·4	2·95	9	— 7·30
Batticaloa	84·7	+0·6	73·6	—0·7	76	88	5·2	5·22	12	— 8·64
Colombo	87·2	+2·2	71·7	—1·8	75	93	4·0	5·72	7	— 7·37
Diyatalawa	74·4	+0·3	57·8	—2·4	76	94	4·9	3·78	13	— 6·64
Galle	85·6	+2·3	73·9	—0·4	81	90	3·8	3·47	10	— 8·54
Hakgala	69·1	+0·4	57·0	+2·1	—	—	5·4	3·34	10	— 8·99
Hambantota	85·4	+0·2	73·8	—0·2	78	90	5·4	7·55	10	— 0·02
Jaffna	85·8	+2·1	74·8	+0·1	69	86	3·3	1·37	6	—15·90
Kandy	86·4	+2·7	66·5	—1·7	72	89	3·5	1·97	11	— 9·05
Kurunegala	89·5	+2·7	70·2	—1·8	68	90	3·2	0·52	6	—11·87
Lunuwila	88·9	+3·1	71·5	—1·3	74	95	3·2	0·56	4	—13·20
Mannar	86·2	+1·8	75·4	—0·1	73	84	3·8	3·30	10	— 6·89
Nuwara Eliya	68·2	+0·6	46·5	—5·1	75	86	6·0	1·15	12	— 8·04
Puttalam	88·1	+2·7	71·8	—1·5	73	90	3·0	1·59	6	— 8·54
Ratnapura	88·7	+1·5	71·1	—1·3	73	93	3·9	11·77	13	— 3·02
Talawakele	75·8	+2·4	54·2	—3·4	70	87	4·7	2·85	8	— 5·65
Trincomalee	83·7	+0·2	74·9	+0·2	78	88	6·6	7·05	10	— 6·89

This month proved to be one of the driest Novembers on record, and several parts of the Island which normally receive 10 to 15 inches of rain, or more, only experienced amounts of the order of 2 inches. The district of Jaffna and parts of the districts of Kurunegala, Kegalla, Kandy and Nuwara Eliya, suffered in this way. Not one station in the Island recorded an excess.

The area worst affected was the peninsula of Jaffna, Jaffna town recording an insignificant 1·37 inches against an average of 17·27 inches (Jaffna College 1·84 inches against 17·62 inches), and Chavakachcheri 1·90 inches against 19·65 inches. These totals are the lowest on record for November, during 77 years of observations at Jaffna (58 years at Jaffna College) and 54 years at Chavakachcheri. Similarly, a number of long-standing stations in the other districts created new low records for November. Thus Kurunegala's 0·52 inches is the lowest in 61 years, Ambanpitiya's 1·86 inches lowest in 76 years, Kandy's 1·97 inches lowest in 78 years, Padupola's 1·79 inches lowest in 77 years, and Nuwara Eliya's 1.15 inches lowest in 79 years.

Rainfall deficits in November exceeded 5 inches almost throughout the Island, the largest being 17·75 inches at Chavakachcheri, 15·95 inches at Ramanathan College and 15·90 inches at Jaffna. Smallest deficits, below 2 inches, occurred at a few stations near Hambantota.

Rainfall was heaviest in a small area in the Nitre Cave District, where Upper St. Martin's Estate recorded 21·12 inches for the month, Hendon Estate 20·91 inches and Lower St. Martin's Estate 18·53 inches. Apart from this, the only other region which received over 10 inches for the month was the area comprising the northern parts of Ratnapura District and those parts of Kalutara District situated adjacent to it. A total of 18·76 inches was recorded at Gilimalay Estate in the Ratnapura District. At many stations among the central hills and in the North-Western Province the November rainfall was less than two inches.

There were 5 daily falls of 5 inches or over in November, the highest being 6·86 inches at Rayigam Estate on the 19th.

The weather in November was predominantly dry. Local thunderstorm activity was responsible for a fair amount of scattered rains during the periods 10th to 13th and 18th to 23rd. During the last few days of the month, the effect of the north-east monsoon was in evidence.

Temperatures were above average by day, and below average by night. The highest recorded shade temperature was 93·3° at Ratnapura on the 27th, while the lowest air temperature was 38·6° at Nuwara Eliya on the 16th. Humidities were below average, and cloud amounts markedly in deficit. Winds were generally variable.

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STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta	87·9	+0·6	69·5	—1·7	80	97	6·6	8·78	11	— 1·85
Anuradhapura	83·2	+0·1	68·7	—1·6	83	92	6·8	11·24	18	+ 3·72
Badulla	76·1	—0·7	64·1	—0·4	84	94	7·2	8·75	19	— 2·48
Batticaloa	81·4	—0·6	72·3	—1·3	85	95	6·7	23·84	17	+ 6·85
Colombo	84·8	—0·7	71·9	—0·5	76	88	6·1	5·31	8	— 0·30
Diyatalawa	71·9	—0·3	58·7	+0·1	85	94	6·9	5·38	18	— 2·67
Galle	84·3	+0·8	73·0	—0·4	85	95	5·4	3·21	8	— 4·61
Hakgala	66·3	—1·0	53·7	+1·0	88	91	7·4	8·36	19	— 4·65
Hambantota	84·2	—0·3	72·9	—0·1	80	90	7·6	3·11	10	— 2·50
Jaffna	82·3	—0·1	73·0	0	77	88	6·0	6·05	14	— 4·34
Kandy	82·7	—0·5	66·9	—0·4	80	92	6·8	5·79	18	— 2·65
Kurunegala	85·3	—0·7	70·9	+0·2	78	93	6·8	5·36	17	— 1·42
Lunuwila	85·8	—0·6	71·6	—0·3	78	93	5·6	2·23	13	— 2·37
Mannar	82·2	—0·6	74·8	0	78	84	6·2	5·65	11	— 2·14
Nuwara Eliya	66·9	—0·9	48·7	0	82	87	7·6	4·76	15	— 3·05
Puttalam	84·0	—0·8	70·9	—0·4	80	93	6·0	4·49	12	— 1·06
Ratnapura	88·0	—0·1	71·4	—0·3	74	93	5·5	5·74	11	— 3·38
Talawakele	72·8	—0·9	55·9	—0·2	81	91	5·8	5·37	12	+ 0·19
Trincomalee	80·6	—0·5	73·5	—1·2	85	90	7·2	29·08	16	+16·08

Rainfall in December was distributed irregularly on both sides of average, deficits covering the larger area. Excesses were found chiefly on the east side of the Island and in the Matara District, the largest excesses being 16·15 inches at Manalputty Aar, 16·08 inches at Trincomalee, 14·94 inches at Andankulam, 13·46 inches at Kalmunai and 12·51 inches at Kadukkamunai. The larger deficits, generally of the order of two to five inches, were found scattered over the rest of the Island, the largest deficits, however, 13·10 inches at Illukkumbura, 7·70 inches at Nilloomally Estate, 7·37 inches at Ohiya and 6·94 inches at Maha Uva, being all found on the north-eastern slopes of the hills.

Rainfall for the month was heaviest, over 25 inches, in the neighbourhood of Trincomalee and Batticaloa, and in the Rangala District. Large totals on the east side were the result of unsettled weather conditions which prevailed during the first week, towards the latter part of which heavy widespread rain occurred. The highest totals were 40·90 inches at Gomarankadawela, 37·41 inches at Lower St. Martin's Estate, 34·34 inches at Hendon Estate, 32·43 inches at Upper St. Martin's Estate, 32·03 inches at Manalputty Aar and 31·21 inches at Palampodda. There was a gradual decrease of rainfall towards the west and south. Least rain was experienced in the neighbourhood of Negombo, where the monthly aggregates were below two inches.

There were 41 daily falls of five inches or over in December, most of them occurring on the 5th and 6th. The highest were 9·78 inches at Vaganeri on the 6th, and 9·72 inches at Palampodda on the 5th.

Temperatures were slightly below average. The highest recorded shade temperature was 92·6° at Ratnapura on the 15th, while the lowest air temperature was 36·8° at Nuwara Eliya on the 28th. Humidities were generally above average, and cloud amounts in excess. Winds were northerly.

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